

SPECIFICATIONS OF MATERIALS AND WORKMANSHIP

NEW OFFICE HQ, OPERATIONS, MAINTENANCE & WAREHOUSE BUILDING FOR:

TAYLOR COUNTY RECC

Campbellsville, KY

100% Construction Documents

August 20, 2026



ARCHITECT/INTERIORS

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FIRE PROTECTION ENGINEER**

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CONSTRUCTION MANAGER

**COOPERATIVE BUILDING SOLUTIONS
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PROJECT # 250120.00

PROJECT MANUAL
FOR
Taylor County RECC

100% Construction Documents PACKAGE

250120.00

August 20, 2026

Project Location: Campbellsville, Kentucky	
General Contractor: Cooperative Building Solutions	
Civil Engineer: Pitman Green, LLC 131 North Public Square Greensburg, KY 42743 Specification information on drawings. Structural/Mechanical/Electrical/Plumbing/Fire Prot. Engineer: SSC Engineering, Inc. 18207 Edison Avenue St. Louis, MO 63005	Architect: M+H Architects 12747 Olive Blvd, Suite 150 St. Louis, MO 63141  08/20/2026
	 

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SECTION 000100 – DISCLAIMER**PART 1 – GENERAL****Disclaimer:**

Pursuant to §327.411 of the Revised Statutes of Missouri, Consultant, Mitchell and Hugeback Architects, Inc., and its officers, directors, employees and subconsultants disclaim any responsibility for the contents of any and all plans, specifications, estimates, reports, or other documents or instruments relating to the existence of asbestos or asbestos-containing materials on the site and contained within the Project Manual. The content of any such documents is the responsibility of others.

PART 2 – PRODUCTS (Not Used)**PART 3 – PRODUCTS (Not Used)****END OF SECTION 000100**

SECTION 008500 – COMcheck Envelope Compliance Certificate**PART 1 – GENERAL**

The document titled “Envelope Compliance Certificate”, dated 8/20/26 and prepared by M+H Architects. is hereby made a part of these specifications. The information, conditions, evaluations, recommendations, and considerations contained in the report shall apply to all work of furnishing labor, materials, equipment and services necessary for and reasonably incidental to the completion of the entire project in accordance with the drawings and these specifications.

END OF SECTION 008500



COMcheck Software Version COMcheckWeb

Envelope Compliance Certificate

Project Information

Energy Code: 2015 IECC
Project Title: Taylor County Office HQ
Location: Campbellsville, Kentucky
Climate Zone: 4a
Project Type: New Construction
Vertical Glazing / Wall Area: 17%

Construction Site:

Owner/Agent:

Designer/Contractor:

Additional Efficiency Package(s)

Credits: 1.0 Required 1.0 Proposed
On-site Renewable Energy, 1.0 credit

Building Area

Floor Area

1-Office : Nonresidential

20781

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor ^(a)
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Office]	23242	---	34.8	0.028	0.032
Floor: Unheated Slab-On-Grade, Horizontal with vertical 4 ft., [Bldg. Use 1 - Office] (c)	691	---	10.0	0.640	0.540
NORTH					
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 1 - Office]	1245	35.0	0.0	0.070	0.064
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: Product ID Trifab VersaGlaze 451T, SHGC 0.30, [Bldg. Use 1 - Office] (b)	226	---	---	0.390	0.380
Door: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID x, SHGC 0.40, [Bldg. Use 1 - Office] (b)	45	---	---	0.800	0.770
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 1 - Office]	220	35.0	0.0	0.070	0.064
EAST					
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 1 - Office]	2745	35.0	0.0	0.070	0.064
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: Product ID Trifab VersaGlaze 451T, SHGC 0.30, [Bldg. Use 1 - Office] (b)	585	---	---	0.390	0.380
Door: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID x, SHGC 0.40, [Bldg. Use 1 - Office] (b)	45	---	---	0.800	0.770
SOUTH					
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 1 - Office]	1368	35.0	0.0	0.070	0.064
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: Product ID Trifab VersaGlaze 451T, SHGC 0.30, [Bldg. Use 1 - Office] (b)	154	---	---	0.390	0.380
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 1 - Office]	108	35.0	0.0	0.070	0.064
WEST					
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 1 - Office]	2720	35.0	0.0	0.070	0.064
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.:	295	---	---	0.390	0.380

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor ^(a)
Product ID Trifab VersaGlaze 451T, SHGC 0.30, [Bldg. Use 1 - Office] (b)					
Door: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: Product ID x, SHGC 0.40, [Bldg. Use 1 - Office] (b)	45	---	---	0.800	0.770
Door: Insulated Metal, Swinging, [Bldg. Use 1 - Office]	95	---	---	0.140	0.610

- (a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
- (b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.
- (c) Slab-On-Grade proposed and budget U-factors shown in table are F-factors.

Envelope PASSES: Design 1% better than code

Envelope Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed envelope systems have been designed to meet the 2015 IECC requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Joshua Bender - Senior Project Architect

Signature



8/20/2026

Date

Name - Title

Signature

Date



Project Information

Construction Site: _____ Owner/Agent: _____ Designer/Contractor: _____

Additional Efficiency Package(s)

Allowed Interior Lighting Power

Proposed Interior Lighting Power

Interior Lighting TBD: Invalid building use type



Project Information

Construction Site: _____ Owner/Agent: _____ Designer/Contractor: _____

Allowed Exterior Lighting Power

(a) Wattage tradeoffs are only allowed between tradable areas/surfaces.

(b) A supplemental allowance equal to 500 watts may be applied toward compliance of both non-tradable and tradable areas/surfaces.

Proposed Exterior Lighting Power

Exterior Lighting TBD: Exterior lighting zone not specified (see project screen)



COMcheck Software Version COMcheckWeb

Mechanical Compliance Certificate

Project Information

Energy Code: 2015 IECC
Project Title: Taylor County Office HQ
Location: Campbellsville, Kentucky
Climate Zone: 4a
Project Type: New Construction

Construction Site:

Owner/Agent:

Designer/Contractor:

Additional Efficiency Package(s)

Credits: 1.0 Required 1.0 Proposed
On-site Renewable Energy, 1.0 credit

Mechanical Systems List

Quantity System Type & Description

Mechanical Compliance Statement

Compliance Statement: The proposed mechanical design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2015 IECC requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title

Signature

Date



Inspection Checklist

Energy Code: 2015 IECC

Requirements: 0.0% were addressed directly in the COMcheck software

Text in the "Comments/Assumptions" column is provided by the user in the COMcheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

Section # & Req.ID	Plan Review	Complies?	Comments/Assumptions
C103.2 [PR1] ¹	Plans and/or specifications provide all information with which compliance can be determined for the building envelope and document where exceptions to the standard are claimed.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.4.1 [PR10] ¹	The vertical fenestration area $\leq$ 30 percent of the gross above-grade wall area.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.4.1 [PR11] ¹	The skylight area $\leq$ 3 percent of the gross roof area.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.4.2 [PR14] ¹	In enclosed spaces $>$ 2,500 ft ² directly under a roof with ceiling heights $>$ 15 ft. and used as an office, lobby, atrium, concourse, corridor, storage, gymnasium/exercise center, convention center, automotive service, manufacturing, non-refrigerated warehouse, retail store, distribution/sorting area, transportation, or workshop, the following requirements apply: (a) the daylight zone under skylights is $\geq$ half the floor area; (b) the skylight area to daylight zone is $\geq$ 3 percent with a skylight VT $\geq$ 0.40; or a minimum skylight effective aperture $\geq$ 1 percent.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C406 [PR9] ¹	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the additional energy efficiency package options.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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Section # & Req.ID	Footing / Foundation Inspection	Complies?	Comments/Assumptions
C303.2 [FO4] ²	Slab edge insulation installed per manufacturer's instructions.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C303.2.1 [FO6] ¹	Exterior insulation protected against damage, sunlight, moisture, wind, landscaping and equipment maintenance activities.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C104 [FO3] ²	Installed slab-on-grade insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C402.2.6 [FO12] ³	Radiant heating systems panels insulated to $\geq R-3.5$ on face opposite space being heated.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.

Additional Comments/Assumptions:

Section # & Req.ID	Framing / Rough-In Inspection	Complies?	Comments/Assumptions
C303.1.3 [FR12] ²	Fenestration products rated in accordance with NFRC.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C303.1.3 [FR13] ¹	Fenestration products are certified as to performance labels or certificates provided.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.4.3 [FR10] ¹	Vertical fenestration SHGC value.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C402.4.3, C402.4.3.4 [FR8] ¹	Vertical fenestration U-Factor.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C402.4.4 [FR14] ²	U-factor of opaque doors associated with the building thermal envelope meets requirements.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C402.5.1.2.2 [FR20] ¹	The building envelope contains a continuous air barrier that is sealed in an approved manner and average assembly air leakage ≤ 0.04 cfm/ft ² . Air barrier penetrations are sealed in an approved manner.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.5.2, C402.5.4 [FR18] ³	Factory-built fenestration and doors are labeled as meeting air leakage requirements.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.5.7 [FR17] ³	Vestibules are installed on all building entrances. Doors have self-closing devices.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

Section # & Req.ID	Mechanical Rough-In Inspection	Complies?	Comments/Assumptions
C402.5.5, C403.2.4.3 [ME3] ³	Stair and elevator shaft vents have motorized dampers that automatically close.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.5.5, C403.2.4.3 [ME58] ³	Outdoor air and exhaust systems have motorized dampers that automatically shut when not in use and meet maximum leakage rates. Check gravity dampers where allowed.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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Section # & Req.ID	Insulation Inspection	Complies?	Comments/Assumptions
C303.1 [IN3] ¹	Roof insulation installed per manufacturer's instructions. Blown or poured loose-fill insulation is installed only where the roof slope is ≤3 in 12.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C303.1 [IN10] ²	Building envelope insulation is labeled with R-value or insulation certificate providing R-value and other relevant data.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C303.2 [IN7] ¹	Above-grade wall insulation installed per manufacturer's instructions.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C303.2.1 [IN14] ²	Exterior insulation is protected from damage with a protective material. Verification for exposed foundation insulation may need to occur during Foundation Inspection.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.2.1 [IN17] ³	Insulation intended to meet the roof insulation requirements cannot be installed on top of a suspended ceiling. Mark this requirement compliant if insulation is installed accordingly.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C104 [IN6] ¹	Installed above-grade wall insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C104 [IN8] ²	Installed floor insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C402.2.6 [IN18] ³	Radiant panels and associated components, designed for heat transfer from the panel surfaces to the occupants or indoor space are insulated with a minimum of R-3.5.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C104 [IN2] ¹	Installed roof insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports. For some ceiling systems, verification may need to occur during Framing Inspection.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	See the Envelope Assemblies table for values.
C402.5.1.1 [IN1] ¹	All sources of air leakage in the building thermal envelope are sealed, caulked, gasketed, weather stripped or wrapped with moisture vapor-permeable wrapping material to minimize air leakage.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
C402.5.3 [FI51] ³	Where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening are located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope. Such rooms are sealed and insulated.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.5.6 [FI37] ¹	Weatherseals installed on all loading dock cargo doors.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C402.5.8 [FI26] ³	Recessed luminaires in thermal envelope to limit infiltration and be IC rated and labeled. Seal between interior finish and luminaire housing.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	
C406.5 [FI49] ¹	On-site renewable efficiency package. One of the following levels of renewable energy must be satisfied: provide ≥ 1.75 Btu/h, or ≥ 0.50 watts per square foot of conditioned floor area or provide ≥ 3 percent of the energy used within the building for mechanical and service water heating equipment and lighting.	☐ Complies ☐ Does Not ☐ Not Observable ☐ Not Applicable	

Additional Comments/Assumptions:

SECTION 009000 – GEOTECHNICAL INVESTIGATION REPORT**PART 1 – GENERAL**

The document titled “Taylor County RECC STV Project No. 225-370”, dated May 6, 2026 and prepared by STV, Inc. is hereby made a part of these specifications. The information, conditions, evaluations, recommendations, and considerations contained in the report shall apply to all work of furnishing labor, materials, equipment and services necessary for and reasonably incidental to the completion of the entire project in accordance with the drawings and these specifications.

END OF SECTION 009000



Taylor County RECC Campbellsville, KY

Geotechnical Report

May 6, 2026

Prepared for Cooperative Building Solutions

Prepared by:
STV Incorporated
65 Aberdeen Drive
Glasgow, Kentucky 42141





May 6, 2026

Mr. Andy Kalicak
Cooperative Building Solutions
12755 Olive Boulevard
Suite 200
St. Louis, MO 63141

Re: Report of Geotechnical Investigation
Taylor County RECC
Campbellsville, Kentucky
STV Project No. 225-370

Dear Mr. Kalicak,

STV, Inc. is pleased to submit this geotechnical report that details the results of our geotechnical investigation performed at the above referenced site.

The attached report describes the site and subsurface conditions and also details our recommendations for the proposed project. The Appendices to the report contain a drawing with a boring layout, typed boring logs, results of laboratory testing, and a typical sinkhole treatment detail.

We appreciate the opportunity to be of service to you on this project and hope to provide further support on this and other projects in the future. Please contact us if you have any questions regarding this report.

Respectfully,
STV, INC.

A handwritten signature in blue ink that reads "Dylan Elmore". The signature is fluid and cursive, with the first name "Dylan" and last name "Elmore" clearly distinguishable.

Dylan Elmore, EIT
Geotechnical Engineer

A handwritten signature in blue ink that reads "Jacob Cowan". The signature is fluid and cursive, with the first name "Jacob" and last name "Cowan" clearly distinguishable.

Jacob Cowan, PE
Project Engineer



**REPORT OF GEOTECHNICAL INVESTIGATION
COOPERATIVE BUILDING SOLUTIONS
TAYLOR COUNTY RECC
STV PROJECT NO. 225-370
CAMPBELLSVILLE, KY**

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**REPORT OF GEOTECHNICAL INVESTIGATION
COOPERATIVE BUILDING SOLUTIONS
TAYLOR COUNTY RECC
STV PROJECT NO. 225-370
CAMPBELLSVILLE, KY**

1 GENERAL SITE DESCRIPTION

The proposed site is located north-northwest of the existing Murakami USA facility on Watertower Bypass in Campbellsville, Kentucky. At the time of the investigation, the site was covered with mixed grasses, an existing parking lot, and two existing structures. A gravel lot was located on the southwestern portion of the site, accompanied by an existing gravel driveway that connects to Foundation Drive. The site topography is best described as relatively flat.

It is our understanding that a 14,900 square foot, one-story office building with adjacent parking areas is proposed within the existing pavement and gravel areas on the eastern portion of the site. Proposed additions to the existing structures on the site are about 2,000 and 9,800 square feet. Multiple storage areas and equipment/material pads are proposed across the western portion of the site, with sizes ranging from 1,000 to 7,500 square feet. A communication tower will be located adjacent to the proposed office building. Additionally, a 0.44 acre, 25-year storm detention pond is proposed on the western edge of the site. Total site acreage is on the order of about ten acres. A preliminary grading plan was provided after the completion of drilling operations. Details pertaining to the proposed communication tower were not provided. After reviewing the preliminary grading plan, fill placement within anticipated fill areas is estimated to range between one and 5.5 feet. Cut depths are anticipated to range between one and 1.5 feet. Maximum column and wall loads were not provided.

2 GENERAL SITE GEOLOGY

Available geologic mapping (*Geologic Map of the Campbellsville Quadrangle, Southern Kentucky, 1965, and the Kentucky Geological Survey Geologic Map Information Service* online) shows the site to be underlain by Upper Mississippian-aged Salem and Warsaw Formations. These formations primarily consist of limestone, shale, and siltstone. The limestone is generally described as yellowish gray to medium gray and medium bluish gray in color, fine to coarse grained, medium to thick bedded, crossbedded, arenaceous, argillaceous, cherty, and fossiliferous. The shale is described as being gray to greenish gray in color, calcareous, and fossiliferous; the siltstone is described as being gray in color.

Multiple karst features have been identified within one mile southwest of the site. Karst potential mapping indicates that the site is prone to the formation of karst features. Limestone bedrock, such as the Salem and Warsaw Formations, is susceptible to the creation of karst features, which include solution weathering of the rock leading to cavities, underground streams, and raveling and arching of the overlying soils leading to sinkholes. Within karst landscapes, overburden thicknesses may vary greatly due to the differential rates of chemical weathering and patterns of surface drainage. Previous development can mask the presence of existing karst features. **Therefore, it should be understood and accepted by the owner that there is always some risk**

of future ground subsidence when building in any region where karst activity is known to historically exist.

No other geologic hazards were readily apparent during the investigation; however, it is impossible to fully identify the presence of, or risk for, development of all geologic hazards during the course of a typical geotechnical investigation.

3 SCOPE OF WORK PERFORMED

The geotechnical investigation consisted of performing 15 soil test borings, including two soil test borings with rock core, across the proposed site. The borings were drilled within areas of proposed structures, pavement areas, and the proposed communication tower location. A boring layout is included in Appendix A of this report.

The borings were drilled by an STV drill crew using a track-mounted drill rig equipped with continuous flight, hollow-stem augers and NQ2-sized coring steel. A Geologist-in-Training (GIT) was on site throughout the fieldwork to log recovered soils and rock core encountered during the investigation. During logging, particular attention was given to the soil color, texture, consistency and apparent moisture content. Standard Penetration Tests (SPT's) were typically performed on 2 ½ -foot centers in the upper ten feet and on five-foot centers thereafter. In addition, Shelby tube samples were obtained at select depths. Bulk samples were obtained at select depths from the anticipated asphalt pavement and detention pond areas. Soil samples were collected from the split-barrel samplers and stored in sealed plastic bags at the site. All recovered samples were transported to our laboratory for further classification and testing. The individual soil samples were visually classified by experienced laboratory technicians and verified by a Geotechnical Engineer based on texture, strength and plasticity. A copy of the boring logs is included in Appendix B.

The natural moisture contents were determined in the laboratory along with Atterberg limits, soil unconfined compressive strength, rock core unconfined compressive strength, standard Proctor and California Bearing Ratio (CBR) testing. The results of the laboratory tests are in Appendix C.

The soils were classified in the laboratory in general accordance with the Unified Soil Classification System (USCS). The Unified symbol for each stratum is shown on the legend for the graphical boring logs. The testing was performed in accordance with the generally accepted standards for such tests.

4 RESULTS OF THE INVESTIGATION

4.1 GENERAL

Information provided in the Appendices for this report includes boring locations, results of the laboratory tests, other relevant geotechnical information and a typical sinkhole treatment detail. A description of the subsurface soil, bedrock and groundwater conditions follows.

4.2 SUBSURFACE SOIL CONDITIONS

The generalized subsurface conditions encountered at the boring locations, including descriptions of the various strata and their depths and thicknesses are presented on the Boring Logs in Appendix A.

Topsoil was encountered at the ground surface in Borings B-4, B-6A, and B-8 with thicknesses ranging from 2.5 to 31 inches. Asphalt was encountered at the ground surface in Borings B-1, B-1A, B-2, B-2A, B-6, and B-7 with thicknesses ranging from 2.5 to three inches. Typically, the asphalt was underlain by crushed stone aggregate, which had thicknesses ranging from 2.5 to seven inches. Crushed stone aggregate was encountered at the ground surface in Borings B-3, B-3A, B-4A, B-5, B-5A, and B-9 with thicknesses ranging from 4.5 to 9.5 inches. Beneath the surface materials, lean to fat clay was encountered to the boring termination depths or auger refusal. The clay was typically described as either lean or fat, containing various amounts of sand and chert, brown to reddish brown in color, moist and medium stiff to very stiff in soil strength consistency. **Very soft soil was encountered in Boring B-3 at 19 feet beneath the ground surface and extended to the auger refusal depth of 21.1 feet.**

SPT-N values at the site ranged from zero to 18 blows per foot (bpf), excluding 50+ blow counts, with most values between six and 16 bpf. Corresponding Qp values ranged from 0.75 to greater than 4.5 tons per square foot (tsf), with most values ranging from 1.75 to 4.0 tsf. Together, the SPT-N and Qp values are indicative of medium stiff to very stiff soil strength consistencies.

Atterberg limits testing was performed on representative near-surface samples with the results indicating that the near-surface soils classify as CL (Clay of Low plasticity), lean clay and CH (Clay of High Plasticity), fat clay in accordance with the Unified Soil Classification System (USCS). Test results ranging from 25 to 59 percent for liquid limit values were obtained with corresponding plasticity indices ranging from nine to 35 percent. Natural moisture contents of the clay soils ranged from 15 to 39 percent with most values ranging between 21 and 30 percent. Typically, the soils were three percent dry to 13 percent wet of the plastic limit.

Unconfined compressive strength tests were performed on the undisturbed Shelby tube samples. Results ranged from 1,990 to 7,725 pounds per square foot (psf) with corresponding dry unit weights ranging from 92.8 to 113.7 pounds per cubic foot (pcf), respectively. Unconfined compressive strength test results of the selected soil samples are listed in Table 1 below.

Table 1: Soil Unconfined Compressive Strength Results

Borehole Number	Sample Depth (feet)	Unconfined Compressive Strength (psf)	Dry Unit Weight (pcf)
B-1	6.5-8.5	5,520	105.8
B-2	2.5-4.5	4,400	97.5
B-3	4.0-6.0	4,795	104.2
B-4	3.0-5.0	7,725	97.4
B-5	3.0-5.0	1,990	113.7

Table 1: Soil Unconfined Compressive Strength Results (cont.)

Borehole Number	Sample Depth (feet)	Unconfined Compressive Strength (psf)	Dry Unit Weight (pcf)
B-8	4.0-6.0	7,565	95.5
B-9	8.0-10.0	3,720	92.8

Standard Proctor testing was performed on bulk samples from Borings B-6A and B-9, which resulted in maximum dry densities of 114.3 and 101.1 pcf, with corresponding optimum moisture contents of 14.9 and 22 percent, respectively.

California Bearing Ratio (CBR) testing was performed on the bulk sample obtained from Boring B-6A. Testing resulted in a CBR value of 6.3 percent at 0.2 inches of penetration. We elected to use a CBR value of 4 percent for pavement design.

4.3 BEDROCK CONDITIONS

Refusal, as would be indicated by the Driller on the field boring logs, indicates a depth where essentially no downward progress can be made by the auger. It is normally indicative of a very hard or very dense material such as large boulders or the upper bedrock surface or where the N-value indicates essentially no penetration of the split-spoon sampler. At this site, auger refusal depths ranged from 3.5 to 21.1 feet below the existing ground surface. The table below summarizes the auger refusal depths encountered at the site.

Table 2: Bedrock Conditions Summary

Boring Number	Auger Refusal Depth (ft)	Boring Termination Depth (ft)
B-1	NR ¹	20.5
B-1A	10.4	15.5
B-2	16.0	16.0
B-2A	8.9	8.9
B-3	21.1	21.1
B-3A	NR ¹	10.5
B-4	12.0	12.0
B-4A	NR ¹	10.5
B-5	13.8	13.8
B-5A	5.0	5.0
B-6	3.5	8.5
B-6A	NR ¹	10.5
B-7	4.7	4.7
B-8	12.8	12.8
B-9	19.8	19.8

¹NR – Auger refusal was not encountered within borehole.

Recovered rock core was typically described as limestone. The limestone was described as being light gray to dark gray in color, fine to medium grained, thick bedded, hard and arenaceous.

Recovered rock core was logged as it was extruded from the coring equipment, with total recovery and Rock Quality Designation (RQD) being measured in the field. Recovery ranged from 92 to 100 percent, with most values being 100 percent. Associated RQD percentages ranged from 86 to 92, with most values 91.

Unconfined compressive strength testing was performed on select rock core samples. Results indicated unconfined compressive strengths ranging from 3,935 to 12,900 pounds per square inch (psi). The results of the unconfined compressive strength testing are summarized in the table below.

Table 3: Unconfined Compressive Strength of Rock Core Samples

Boring Number	Depth (ft)	Height (in)	Diameter (in)	L/D Ratio	Weight (g)	Unit Weight (pcf)	Unconfined Compressive Strength (psi)
B-1A	10.5-10.8	4.02	1.97	2.0	530.7	165.5	9,510
B-1A	12.9-13.2	4.16	1.96	2.1	529.5	160.5	8,855
B-1A	15.0-15.3	4.12	1.96	2.1	538.0	164.5	12,900
B-6	3.7-4.0	3.97	1.95	2.0	496.6	159.0	7,620
B-6	6.7-7.0	4.16	1.95	2.1	500.4	153.1	8,725
B-6	8.0-8.3	4.10	1.96	2.1	464.4	143.4	3,935

4.4 GROUNDWATER CONDITIONS

Groundwater was not encountered in any of the borings performed at this site. In cohesive soils such as those encountered at the site, a long time is required for the hydrostatic groundwater level to come to equilibrium in the borehole. The short-term groundwater levels reported by the drill crew are not generally indicative of the long-term groundwater level. To accurately determine the long-term groundwater level, as well as the seasonal and precipitation induced fluctuations of the groundwater level, it is necessary to install piezometers in the borings and monitor them for an extended length of time. Frequently, groundwater conditions affecting construction in this region are caused by trapped or perched groundwater, which occurs within the soil materials or at the soil/rock interface in irregular, discontinuous locations. If these water bodies are encountered during excavation, they can produce seepage durations and rates that will vary depending on the recent rainfall activity and the hydraulic conductivity of the material.

4.5 SEISMIC CONDITIONS

According to the Kentucky Building Code, 2018 Edition and the subsurface conditions encountered in the borings, Site Class C should be utilized for any seismic structural design for foundations bearing on native soil.

Consideration for seismic loading and liquefaction potential beyond this level of investigation is left to the discretion of the structural and foundation design engineer.

5 ANALYSES AND RECOMMENDATIONS

The recommendations that follow are based on our conceptual understanding of the project. As the site design is advanced, please notify us of any significant design changes so that our recommendations can be reviewed and modified as necessary.

5.1 GENERAL SITE WORK

5.1.1 On-Site Soils

The near-surface soils on this site are residual clays which classify as low plasticity lean clay, CL and high plasticity fat clay, CH in accordance with the USCS. Efforts should be made to schedule earthwork activities during the late spring to early fall months since these soils will pump, rut and lose strength with moisture contents more than several points wet or dry of the optimum moisture content for compaction.

5.1.2 General Fill Requirements

Any material, whether borrowed on-site or imported to the site, placed as engineered fill on the project site beneath the proposed building or other proposed on-grade structures such as pavement, parking lots, sidewalks, etc., should be an approved material, free of environmental contamination, vegetation, topsoil, organic material, wet soil, construction debris, and rock fragments greater than six inches in diameter. We recommend that any borrow material, if needed, consist of granular or lean clay materials or mixtures thereof with Unified Classifications of CL, SC, or GC. **We further recommend high plasticity clays, known as fat clays (CH soils) not be imported to the site due to their potential for volume changes with fluctuations in moisture content.**

The preferred borrow material should have a Plasticity Index (PI) less than 30 and a standard Proctor maximum dry density of at least 95 pcf. Engineering classification and standard Proctor tests should be performed on all potential borrow soils and the test results evaluated by an STV Geotechnical Engineer to evaluate the suitability of the soil for use as engineered fill.

5.1.3 Off-Site Soils

If off-site material is needed, it should meet the requirements specified in *Section 5.1.2 General Fill Requirements*.

5.1.4 Topsoil Stripping/Asphalt Pavement Removal

Prior to earthwork operations, topsoil and surface plant material root mat should be stripped from both cut and fill areas and stockpiled for landscaping purposes.

Asphalt pavement shall be removed prior to fill placement or may remain in place provided it is rubblized to a maximum size and gradation that will facilitate construction. If practical, pavement areas to be reworked should not be removed until just prior to new pavement construction to avoid damaging subgrade soils due to cyclical loading from construction traffic during wet periods.

5.1.5 Subgrade Evaluation/Conditioning

Once the topsoil is removed, areas to receive fill should be “proof-rolled” under the observation of an STV Geotechnical Engineer or Engineering Technician to evaluate the subgrade for suitability for fill placement. The proof-rolling should be performed using heavy construction equipment such as a fully loaded single or tandem axle dump truck (approximately 20-25 tons), passing repeatedly over the subgrade at a slow rate of speed.

Subgrade soils that are considered unstable after proof-rolling should be stabilized by additional compaction or by one or more of the following methods: in-place stabilization using chemical methods (lime/soil cement), removal and replacement with engineered fill, partial depth removal and replacement with a crushed (angular) aggregate layer, or partial depth removal and replacement with a geogrid and a crushed aggregate layer. The specific method of treatment will be based on the conditions present at the time the proof-rolling is performed and local availability of materials and economic factors. The selection of the appropriate method to mitigate degrading subgrade soils is dependent on the time of year site work is anticipated, cost, anticipated effectiveness, and scheduling impacts. STV can assist in selecting this method considering all factors.

Once the subgrade is judged to be relatively uniform and suitable for support of engineered fill, fill areas should be brought to design elevations with onsite soil and/or suitable off-site borrow material placed and compacted as specified in *Section 5.1.8 Fill Placement*.

5.1.6 Expansive Clays

Fat clay soils are prevalent across the site and have high swell potentials. In general, these expansive clays will tend to shrink or swell with long-term decreases or increases in moisture content. **For this reason, it is recommended that the CH soils excavated on-site not be placed in the upper two feet beneath the building floor slabs. When CH soils are encountered in the upper two feet of the subgrade in cut areas, the CH soils should be removed to a depth of two feet below proposed subgrade and replaced with clay soils that have a plasticity index (PI) of 30 percent or less.**

In general, the plasticity of the residual clay soils at this site increases with depth, which means that the more undesirable CH soils are at greater depths and will be excavated last. Selective handling techniques that include stockpiling of the upper CL soils for placement in the upper two feet of the building pad subgrade will be necessary at this site. If this is not practical, lime stabilization of the upper two feet of the building pad may be considered to lower the plasticity of the CH soils.

5.1.7 Sinkhole Treatment

If dropouts or sinkholes are detected during site grading or proof-rolling, they should be treated by excavated to the bedrock surface and constructing a graded filter over the sinkhole throat in areas where the depth to bedrock is less than 20 feet. In areas where bedrock is deeper than 20 feet or in areas close to existing structures where excavations may negatively affect existing foundations, compaction grouting should be performed to densify and fill any voids in the soil

overburden. A sketch of a typical sinkhole treatment is included in Appendix D. These areas should be excavated under the observation of an STV Geotechnical Engineer to determine the lateral and vertical extent of any voids.

5.1.8 Fill Placement

Lean clay, CL, soil placed under building areas should be placed in maximum eight inch (loose thickness) horizontal lifts, with each lift being compacted to a minimum of 98 percent of the standard Proctor maximum dry density, at a moisture content within two percent of optimum. The compaction requirement may be reduced to 95 percent in proposed paved areas and to 92 percent in proposed landscape areas. Based on the results of moisture content tests performed in the borings, drying of the on-site soils will be necessary to achieve moisture contents suitable for compaction. Representative and adequate field density testing should be performed by STV to verify that compaction requirements have been met.

Due to encountering unsuitable, near-surface soils within the proposed office building pad area, a working platform should be constructed by undercutting at least **one** foot of the existing clay material, followed by placing **two** feet of No. 2 or No. 3 stone in order to create a suitable platform for fill placement.

5.1.9 Soil Movement

Site grading should be maintained during construction so that positive drainage is promoted at all times. Final site grading should be accomplished in such a manner as to divert surface runoff and roof drains away from the foundation elements and paved areas. Precipitation runoff should be collected in storm sewers as quickly as possible. Maintenance should be performed regularly on paved areas to seal pavement cracks and reduce surface water infiltration into the pavement subgrade.

5.1.10 Site Drainage Considerations

In areas underlain by limestone bedrock, concentrated stormwater runoff can cause sinkhole dropouts that result in relatively expensive remediation costs. It is important to maintain positive site drainage to direct water away from structural areas both during and after construction. The following recommendations should be utilized to ensure proper site drainage during and after construction:

- Storm drains should be designed and constructed in the same manner as sanitary sewer systems to prevent leakage at connections, (i.e., pipes connecting into drop boxes).
- Utility trenches should be effectively sealed to restrict water intrusion and flow through trenches.
- Grades must provide effective drainage away from buildings during and after construction. Roofs should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least ten feet from the building.

5.1.11 Site Soil Practices

Working with the on-site soils will demand sensible construction practices and techniques. Some of these include:

- Prevent stripping too far in advance of actual earthwork needs. Problems arise when broad areas of clay/silt mixtures are exposed and allowed to become wet and soft from rainfall. Once saturated, deep rutting can occur by movement of construction equipment.
- Strip areas to receive fill in small, sequential areas as needed. These areas should be limited to the contractor's abilities to reasonably place and compact fill material.
- Schedule earthwork construction to take full advantage of a summer season. Generally, the on-site clays need to be placed at two percent wet of optimum moisture content to achieve compaction and reduce the potential for subgrade volume change. This moisture range is difficult to achieve in the winter and early spring when rainfall activity is more prevalent and soil drying is not always possible.
- Maintain good surface drainage during earthwork construction. Grade construction areas on a daily basis if necessary to promote sheet drainage of precipitation and seal all engineered fill placed with a smooth drum steel roller at the end of each day.
- Perform frequent density tests during fill placement to confirm achievement of proper compaction.

5.2 STRUCTURE FOUNDATIONS

5.2.1 Recommended Bearing Capacity Values

The on-site soils are generally suitable for support of isolated spread and continuous wall footings. An allowable bearing capacity of 1,500 psf can be utilized for design of foundation elements bearing on engineered fill or granular replacement.

Based on the SPT-N values obtained at the site, some undercutting may be required in areas near Boring B-5, B-6, and B-7 to meet the design bearing capacity. The amount of undercutting will likely increase if construction occurs during long, wet periods such as those typically encountered from late fall to early spring. Where footings fail to meet the design bearing capacity, the footings should be undercut to suitable bearing material or generally to a maximum depth below design bearing elevation equal to twice the plan width of the footing. Footings which are undercut due to low bearing capacity may be backfilled to the design bearing elevation with KYTC No. 57 stone or engineered fill wrapped in AASHTO M288 Class 1A geotextile fabric per *Section 5.1.8 Fill Placement*.

These recommendations are provided in consideration of the field-testing, laboratory testing, local codes, and our experience with materials of similar description.

5.2.2 Soil Bearing Recommendations

5.2.2.1 Lateral Design Parameters

The lateral soil parameters presented in Table 4, based on estimations by Matlock (1970) for soft clays with free water, should be utilized in the design of drilled shafts for the proposed communication tower. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02.

Table 4: L-Pile Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (ft)	Estimated Strain at 50% Shear Strength (ϵ_{50})	Initial Soil Stiffness (k_{py}) (pci)
B-1A	CH	5.0-10.4	0.005	405

5.2.2.2 Axial Soil Parameters

Axial soil parameters recommended for drilled shaft design, as shown in Table 5, should be utilized for drilled shafts designed for the proposed communication tower. These values are derived from laboratory and standard penetration testing in combination with recommended soil properties from the Naval Engineering Command (NAVFAC) Design Manual 7.02. The ultimate friction angle for clay in contact with concrete of 17° should be used for design. For cohesive soils, utilize a skin friction resistance factor (ϕ) of 0.45 in accordance with the Brown et. al. (2010) method.

Table 5: Axial Soil Parameters for Design of Drilled Shafts

Structure Number	Lithology	Depth (ft)	Effective Unit Weight (pcf)	Undrained Shear Strength (S_u) (ksf)	Nominal Unit Side Resistance (f_{SN}) (ksf)
B-1A	CH	5.0-10.4	125.0	2.0	1.1

5.2.3 Recommended Minimum Footing Dimensions

The minimum recommended width of continuous wall footings is 18 inches. The minimum recommended plan dimension for isolated spread footings is 24 inches. Actual foundation sizes should be determined by the foundation engineer based on design structure loads and the net allowable bearing value presented in *Section 5.2.1 Recommended Bearing Capacity Values*.

5.2.4 Grade Supported Floor Slab Recommendations

We recommend on-grade supported floor slabs be isolated from the building foundations and allowed to float free and settle differentially with the building. We have estimated an Effective Modulus of Subgrade Reaction (k) of 90 pci. The final floor slab design, including the amount of and type of steel reinforcement (welded wire mesh or bar reinforcing) will be dependent on the structural engineer's evaluation of the final grade slab thickness, concrete compressive strength, and actual slab loadings. Additional design and construction recommendations are provided as follows:

- Proof-rolling of the cut subgrade and existing subgrade should be performed to identify soft or unstable soil prior to engineered fill placement. Soft soils should be removed to the extent determined in the field by the STV Geotechnical Engineer or Technician. Proof-rolling of the final floor slab subgrade should also be performed prior to floor slab construction and any defects appropriately repaired as recommended in the field by STV.
- The floor slab should be supported on a minimum 4-inch compacted layer of free draining granular base material to distribute concentrated loads, improve drainage, and reduce the risk of deterioration of the prepared subgrade during construction. The stone should be kept moist, not wet, immediately before placement of concrete to limit differential curing conditions at the top and bottom of the slab.
- A vapor barrier is recommended to prevent water vapor transmissions that have the potential to adversely affect the floor coverings ability to bond to the slab. Recommendations from ACI 302.1 R 96, "Guide for Concrete Floor and Slab Construction," should be utilized. Joints between slab sections should contain keys or dowels to permit slab rotation but to reduce extreme vertical differential displacements.

5.2.5 Footing Trenches

We recommend that the bottom of exterior strip and spread footings extend a minimum of 24 inches below finished exterior grade to provide protection against frost penetration related problems in normal winters. Interior foundations not exposed to severe drying, freezing temperatures, and/or severe moisture fluctuations can be constructed at relatively shallow depths as appropriate for construction; however, for interior footings not normally susceptible to frost, effects of frost heave during construction should be considered. Foundation construction should follow these recommendations:

- Foundation concrete should be placed in the excavations the same day the trenches are cut.
- Exposed bearing surfaces should be protected from severe drying, freezing, and water accumulation. A concrete "mud-mat" may be constructed over the bearing materials if the excavation must remain exposed to the elements for an extended period of time.
- Any loose soil, debris, or excess water should be removed from the bearing surface prior to concrete placement.
- The foundation-bearing surface should be level or appropriately benched.
- Foundation materials that have deteriorated as a result of the elements should be removed prior to concrete placement.
- Foundation trenches should be "clean-cut" where possible and constructed without the use of forms.

- Reinforcing steel should be placed in all footings to provide strength to distribute loads on the foundation that may be overlying weak or more compressible foundation materials to stronger adjacent materials.

5.2.6 Below Grade Walls

Lateral earth pressures are influenced by structural design, wall restraint conditions, construction equipment and methods and backfill material properties. Three wall restraint conditions are presented below in the form of “at-rest”, “active” and “passive” lateral earth pressure conditions. The “at-rest” (K_o) condition is applicable when lateral movement is prevented by an unyielding element and assumes no wall movement. The “active” (K_a) condition is used for design of free-standing cantilever walls and assumes wall movement as indicated below. The “passive” condition occurs when a soil mass is externally forced laterally and inward (towards the soil mass) to the point of mobilizing its available full shear resistance. Below grade walls for the structures, if necessary, should be designed for earth pressures at a minimum of those indicated in Table 6 below.

Table 6: Earth Pressure Coefficients

Earth Pressure Condition	Earth Pressure Coefficient	Equivalent Fluid Pressure (pcf)	Equivalent Fluid Pressure w/ Hydrostatic Pressure (pcf)
Active (K_a)	0.51	64	97
At-Rest (K_o)	0.67	84	108
Passive (K_p)	1.97	119*	95*

*Factor of safety 2.0 utilized.

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.0002 H to 0.004 H, where H is wall height.
- Uniform surcharge behind the wall is not accounted for in the values presented above.
- Loading from heavy construction equipment is not included.
- Dynamic loading is not included.
- No safety factors included in soil parameters except where noted.
- Hydrostatic pressure should be accounted for unless positive backfill drainage conditions can be achieved.
- A friction coefficient between the subgrade soils and foundation concrete has been estimated to be 0.3 for mass concrete in contact with lean/fat clay. The friction factors provided are based on results of soil classification testing.
- A friction angle of 19° was utilized for calculating earth pressure coefficients for cohesive soil backfill.

5.2.7 Excavation Safety

Temporary excavations should be properly placed in accordance with the Kentucky Occupational Safety and Health Standards for the Construction Industry 29 CFR Part 1926 Subpart P - Excavations. The soil overburden at the site consists of Type B soils. Type B soils at the site should be laid back on temporary slopes not exceeding 1 Horizontal: 1 Vertical (1H:1V) in excavations not exceeding 20 feet in depth. Sloping or benching for excavations greater than 20 feet deep should be designed by a registered professional engineer.

5.2.8 Potential Foundation Movement

A detailed settlement analysis was beyond the scope of this investigation. Soil bearing spread footings would be anticipated to experience ¼-inch of total settlement with less than ½-inch of differential settlement.

These estimates assume that the foundations are designed and constructed according to the recommendations in this report and in conjunction with sound foundation construction practice.

5.3 PAVEMENT DESIGN

Flexible and rigid pavement designs were performed for light and heavy-duty pavements. ESAL's (equivalent 18-kip single axle loads) of 150,000 were used for heavy duty sections assuming full turnover two times per day with light vehicular traffic and occasional garbage and semi-trucks, and delivery vehicles. ESAL's of 35,000 were used for light-duty sections. A CBR value of 4 was utilized for design.

Our analysis was made using the *AASHTO Guide for Design of Pavement Structures (1993 Edition)* and the following parameters:

- Subgrade Resilient Modulus (M_r) = 6,000 psi
- CBR value = 4
- Initial Serviceability = 4.2
- Terminal Serviceability = 2.0
- Reliability = 90%
- Standard Deviation = 0.49
- ESAL's = 150,000 (Heavy Duty), 35,000 (Light-Duty)
- Design Life = 20 Years
- Drainage Coefficient = 1.0
- Layer Coefficient = 0.44 for asphaltic surface, 0.40 for asphaltic base, 0.14 for crushed aggregate base.

Pavement performance is highly dependent on the support provided by the subgrade that can be greatly impacted by changes in the moisture condition of the subgrade. Measures that reduce the risk of the subgrade becoming saturated should be incorporated into the site design. Pavement slopes should have a minimum gradient of two percent where possible. Pavement edges should be "daylighted", or provided a means where water trapped in the aggregate base can escape by

extending the aggregate base course through the sides of drainage channels. The use of underdrains in low areas, and/or spider drains at stormwater catch basins should also be considered within the paved area.

5.3.1 Flexible Pavement

Using the design parameters previously outlined, a recommended *light-duty* pavement should at a minimum consist of an 8-inch dense graded aggregate (DGA) or crushed stone base (CSB) aggregate base course, a 2¼-inch bituminous base course, and a 1 ¼-inch bituminous surface course. This design would be appropriate for passenger vehicle traffic only with delivery truck traffic twice a week.

A recommended minimum *heavy-duty* pavement would consist of a 10-inch dense graded aggregate (DGA) or crushed stone base (CSB) aggregate base course, a 3-inch bituminous base course, and a 1 ½-inch bituminous surface course. This design would be appropriate for loaded semi-trucks and garbage truck traffic.

5.3.2 Aggregate Base Paving

We recommend the Bituminous Pavement aggregate subbase consist of dense graded aggregate (DGA) or crushed stone base (CSB) meeting the requirements of Section 805 of the KYTC Standard Specifications for Road and Bridge Construction 2019. The aggregate subbase should be placed in maximum 4-inch-thick horizontal lifts, with each lift being compacted in accordance with the control strip guidelines set forth in Section 302 of the *KYTC Standard Specifications for Road and Bridge Construction 2019*.

5.3.3 Rigid Pavement

We have estimated an Effective Modulus of Subgrade Reaction (k) of 100 pci and various other parameters for rigid pavement design. A minimal recommended heavy-duty rigid pavement design would consist of 4-inches of Crushed Stone Base underlying 6-inches of Portland Cement Concrete Pavement with a 28-day compressive strength of 4,000 psi and a corresponding modulus of rupture (MR) of 625 psi. The concrete used to construct the pavement should have four to six percent entrained air to improve the concrete's resistance to spalling from saturated freeze-thaw cycles. This section is a heavy-duty section.

Control joints, filled with a fuel resistant seal to deter liquid intrusion into the subgrade, should be incorporated at 25-foot spacings.

5.4 GENERAL CONSIDERATIONS

5.4.1 Construction Monitoring/Testing

Field density and moisture content determinations should be made on each lift of fill with a minimum of one test per 3,000 to 5,000 square feet in building pad areas, one test per lift per 5,000 to 10,000 square feet in other fill areas, and one test per lift per 100 to 200 linear feet of utility trench backfill. All construction operations involving earthwork and paving should be

performed in the presence of an experienced representative of STV. The representative would operate under the direct supervision of an STV Geotechnical Engineer. Some adjustments in the test frequencies may be required based upon the general fill types, changes in the fill material and soil conditions at the time of placement.

Site problems can be avoided or reduced if proper field observation and testing services are provided. We recommend all foundation excavations, proof-rolling, site and subgrade preparation, subgrade stabilization (if used), and pavement construction be monitored by STV. Density tests should be performed to verify compaction and moisture content for all earthwork operations. Field observations should be performed prior to and during concrete placement operations.

5.4.2 Earthwork Considerations

The surface soils at the site are susceptible to loss of bearing capacity (pumping) by the action of water and construction equipment. Once the subgrade has been stripped, cut to grade, and passed a proof-roll, it should be sealed at the end of each filling day with a smooth drum roller and sloped to sheet drain rainwater. Any material disturbed by rainwater and construction operations should be undercut prior to placing the next lift of fill.

If the project is to begin in the fall and continue through the winter, care must be taken not to place frozen soil, as proper compaction will be impractical. Moisture contents must also be carefully monitored during the winter, as wet soil will be difficult to dry.

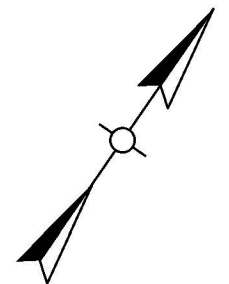
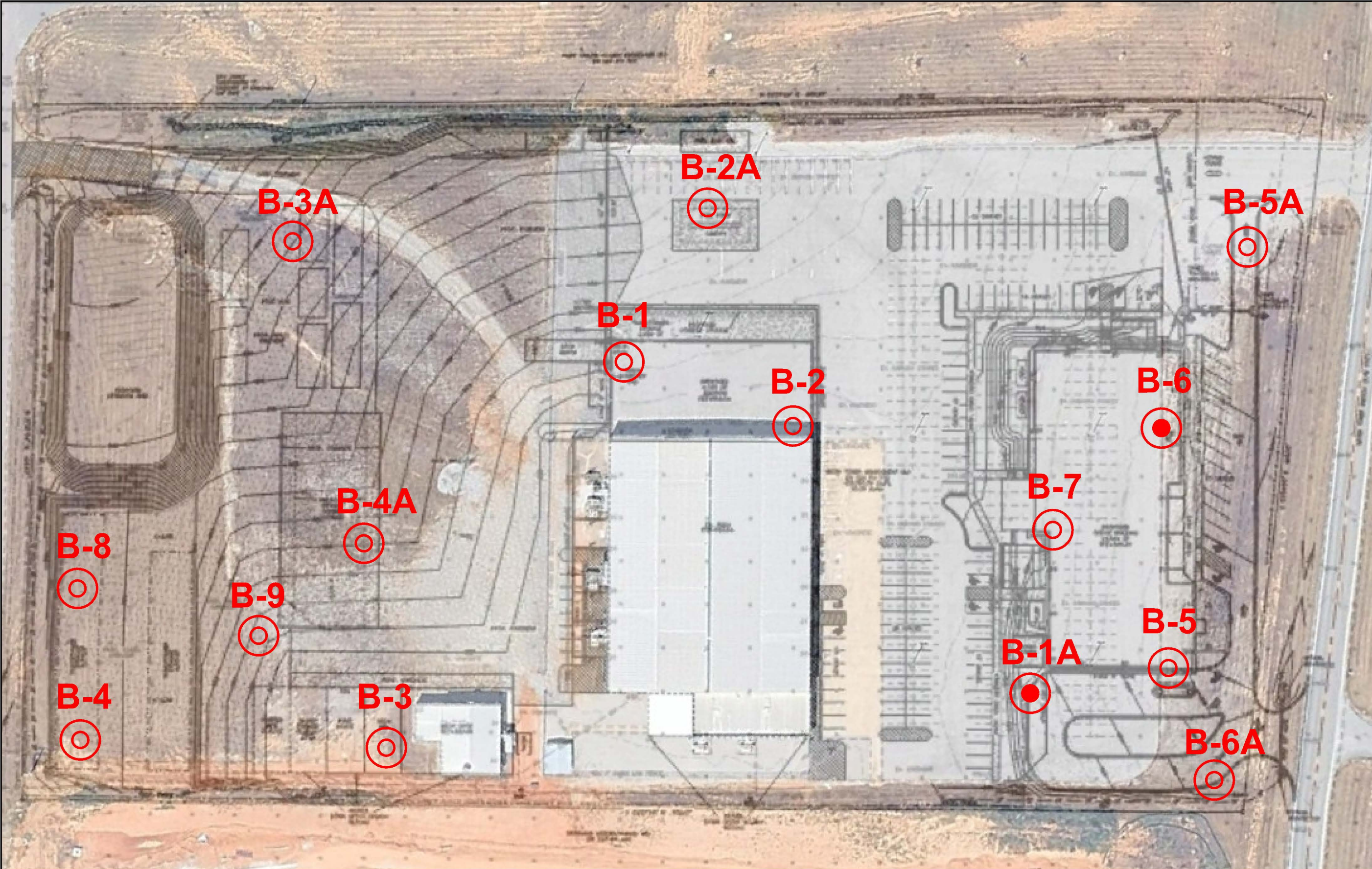
5.4.3 Limitations

The conclusions and recommendations presented herein are based on information gathered from the borings advanced during this investigation using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions between the borings. We will retain samples acquired for this project for a period of 30 days subsequent to the submittal date printed on the cover of this report. After this period, the samples will be discarded unless otherwise requested.



APPENDIX A

Boring Layout



LEGEND

- ⊙ SOIL TEST BORING
- SOIL TEST BORING WITH ROCK CORE

DRAWING NOT TO SCALE
ALL BORING LOCATIONS ARE APPROXIMATE

REVISION	DESCRIPTION
NO.	
DATE	

BORING
LAYOUT

CLIENT:
Cooperative Building Solutions

PROJECT:
TAYLOR COUNTY RECC
CAMPBELLVILLE, KY



SCALE:
NTS

DATE:
03-31-2026

DRAWN BY:
D. ELMORE

CHECKED BY:
J. COWAN

FILE:
Taylor County RECC\Projects\225-370
Taylor County RECC\Geotech
Reports\Report Parts

SHEET:
A-1



APPENDIX B

Typed Boring Logs

FIELD TESTING PROCEDURES

The general field procedures employed by the Field Services Center are summarized in the following outline. The procedures utilized by the AEI Field Service Center are recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Soil Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the surface conditions. Borings are advanced into the ground using continuous flight augers. At prescribed intervals throughout the boring depths, soil samples are obtained with a split-spoon or thin-walled sampler and sealed in airtight glass jars and labeled. The sampler is first seated 6 inches to penetrate loose cuttings and then driven an additional foot, where possible, with blows from a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler each six-inch increment is recorded. The penetration resistance, or "N-value" is designated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split spoon sampling procedures used during the exploration are in general accordance with ASTM D 1586. Split spoon samples are considered to provide *disturbed* samples, yet are appropriate for most engineering applications. Thin-walled (Shelby tube) samples are considered to provide *undisturbed* samples and obtained when warranted in general accordance with ASTM D 1587.

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

Core Drilling Procedures for use on refusal materials. Prior to coring, casing is set in the boring through the overburden soils. Refusal materials are then cored according to ASTM D-2113 using a diamond bit attached to the end of a hollow double tube core barrel. This device is rotated at high speeds and the cuttings are brought to the surface by circulating water. Samples of the material penetrated are protected and retained in the inner tube, which is retrieved at the end of each drill run. Upon retrieval of the inner tube the core is recovered, measured and placed in boxes for storage.

The subsurface conditions encountered during drilling are reported on a field test boring record by the driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soil in general accordance with the procedures outlined in ASTM D 2487 and D 2488 and prepares the final boring records which are the basis for all evaluations and recommendations.

Representative portions of soil samples are placed in sealed containers and transported to the laboratory. In the laboratory, the samples are examined to verify the driller's field classifications. Test Boring Records are attached which show the soil descriptions and penetration resistances.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designate the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Water table readings are normally taken in conjunction with borings and are recorded on the “Boring Logs”. These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using as electrical probe to detect the water level surface.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.

Sampling Terminology

Undisturbed Sampling: Thin-walled or Shelby tube samples used for visual examination, classification tests and quantitative laboratory testing. This procedure is described by ASTM D 1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight and transported to the laboratory. Locations and depths of undisturbed samples are shown on the “Boring Logs.”

Baq Sampling: Bulk samples of soil are obtained at selected locations. These samples consist of soil brought to the surface by the drilling augers, or obtained from test pits or the ground surface using hand tools. Samples are placed in bags, with sealed jar samples of the material, and taken to our laboratory for testing where more mass material is required (i.e. Proctors and CBR's). The locations of these samples are indicated on the appropriate logs, or on the Boring Location Plan.

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIVE SOILS (Clay, Silt, and Mixtures)

<u>CONSISTENCY</u>	<u>SPT N-VALUE</u>	<u>Qu/Qp (tsf)</u>	<u>PLASTICITY</u>	
Very Soft	2 blows/ft or less	0 – 0.25	Degree of Plasticity	Plasticity Index (PI)
Soft	2 to 4 blows/ft	0.25 – 0.49	Low	0 – 7
Medium Stiff	4 to 8 blows/ft	0.50 – 0.99	Medium	8 – 22
Stiff	8 to 15 blows/ft	1.00 – 2.00	High	over 22
Very Stiff	15 to 30 blows/ft	2.00 – 4.00		
Hard	30 blows/ft or more	> 4.00		

NON-COHESIVE SOILS (Silt, Sand, Gravel, and Mixtures)

<u>DENSITY</u>	<u>SPT N-VALUE</u>	<u>PARTICLE SIZE IDENTIFICATION</u>	
Very Loose	4 blows/ft or less	Boulders	12 inch diameter or more
Loose	4 to 10 blows/ft	Cobbles	3 to 12 inch diameter
Medium Dense	10 to 30 blows/ft	Gravel	Coarse – 1 to 3 inch
Dense	30 to 50 blows/ft		Medium – ½ to 1 inch
Very Dense	50 blows/ft or more		Fine – ¼ to ½ inch
		Sand	Coarse – 0.6mm to ¼ inch
			Medium – 0.2mm to 0.6mm
			Fine – 0.05mm to 0.2mm
		Silt	0.05mm to 0.005mm
		Clay	0.005mm

RELATIVE PROPORTIONS

<u>Descriptive Term</u>	<u>Percent</u>
Trace	1 – 10
Trace to Some	11 – 20
Some	21 – 35
And	36 – 50

NOTES

Classification – The Unified Soil Classification System is used to identify soil unless otherwise noted.

Standard “N” Penetration Test (SPT) (ASTM D1586) – Driving a 2-inch O.D., 1 3/8-inch I.D. sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6-inches to seat the sampler into undisturbed soil, and then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the field drill log (e.g., 10/8/7). On the report log, the Standard Penetration Test result (i.e., the N value) is normally presented and consists of the sum of the 2nd and 3rd penetration counts (i.e., N = 8 + 7 = 15 blows/ft.)

Soil Property Symbols

Qu:	Unconfined Compressive Strength	N:	Standard Penetration Value (see above)
Qp:	Unconfined Comp. Strength (pocket pent.)	omc:	Optimum Moisture content
LL:	Liquid Limit, % (Atterberg Limit)	PL:	Plastic Limit, % (Atterberg Limit)
PI:	Plasticity Index	mdd:	Maximum Dry Density

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/18/26COMPLETED 3/18/26GROUND ELEVATION 885.5 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 4/14/26 15:40 - I:\GLASGOW-T125 PROJECTS\225-370 TAYLOR COUNTY RECC\GEOTECH\LAB\TREC.CGP

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		ASPHALT (2.5 INCHES)									
		CRUSHED STONE AGGREGATE (2.5 INCHES)									
		(CL) lean CLAY, light brown, moist, stiff	SPT 1	47	2-4-4 (8)	3.75	20				
		(CH) fat CLAY, trace sand, light brown to reddish brown, moist, stiff to very stiff	SPT 2	93	3-6-8 (14)	3.5	28				
5			SPT 3	87	3-5-7 (12)	3.75	18				
			ST 1	55		3.25	28				Qu = 5,520 psf
10			SPT 4	77	3-5-8 (13)	4.5+	26				
15			SPT 5	83	5-7-10 (17)	4.5+	28				
20			SPT 6	100	5-6-10 (16)	3.75	29				

Bottom of borehole at 20.5 feet.



CLIENT Cooperative Building Solutions	PROJECT NAME Taylor County RECC
PROJECT NUMBER 225-370	PROJECT LOCATION Campbellsville, KY
DATE STARTED 3/16/26 COMPLETED 3/16/26	GROUND ELEVATION 890.5 ft
DRILLING CONTRACTOR Adam Thompson	GROUND WATER LEVELS:
DRILLING METHOD HSA/ Diamond impregnated coring bit	AT TIME OF DRILLING --- Dry
LOGGED BY Jennifer Kirk CHECKED BY Dylan Elmore	AT END OF DRILLING ---
NOTES	AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		ASPHALT (3 INCHES)	SPT 1	90	3-4-5 (9)	2.75	26				
		(CL) lean CLAY, trace sand, reddish brown, moist, stiff	SPT 2	80	4-5-6 (11)	3.5	34				
		(CH) fat CLAY, trace sand and chert, reddish brown with tan mottle, moist, stiff	SPT 3	100	4-5-8 (13)	1.75	32				
5			SPT 4	100	3-6-7 (13)	4.0	25				
			SPT 5	100	3-5-50 (55)	2.5	34				
10		LIMESTONE, fine to medium grained, light gray to gray, thick bedded, hard, arenaceous	RC 1	92 (91)							
15			RC 2	100 (86)							

Refusal at 10.4 feet.
Bottom of borehole at 15.5 feet.

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/16/26COMPLETED 3/17/26GROUND ELEVATION 888 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		ASPHALT (2.5 INCHES)									
		CRUSHED STONE AGGREGATE (7 INCHES)									
		(CL) lean CLAY, trace sand and chert, brown to reddish brown with tan mottle, moist, stiff	SPT 1	60	2-5-4 (9)	3.0	25				
		(CH) fat CLAY, trace sand and chert, reddish brown with tan mottle, moist, very stiff to medium stiff	ST 1	38		4.5+	25	56	21	35	Qu = 4,400 psf
5			SPT 2	97	6-7-10 (17)	4.5+	29				
			SPT 3	73	3-4-6 (10)	4.0	28				
10			SPT 4	87	4-5-9 (14)	3.5	26				
15			SPT 5	87	3-2-4 (6)	2.5	29				

Refusal at 16.0 feet.
Bottom of borehole at 16.0 feet.



CLIENT Cooperative Building Solutions	PROJECT NAME Taylor County RECC
PROJECT NUMBER 225-370	PROJECT LOCATION Campbellsville, KY
DATE STARTED 3/17/26 COMPLETED 3/17/26	GROUND ELEVATION 881 ft
DRILLING CONTRACTOR Adam Thompson	GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers	AT TIME OF DRILLING --- Dry
LOGGED BY Jennifer Kirk CHECKED BY Dylan Elmore	AT END OF DRILLING ---
NOTES	AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		ASPHALT (2.5 INCHES)									
		CRUSHED STONE AGGREGATE (6.5 INCHES)									
		(CL) lean CLAY, trace sand and chert, tan with reddish brown mottle, moist, stiff	SPT 1	80	3-5-7 (12)	4.0	16				
			SPT 2	63	4-5-9 (14)	3.0	30	39	17	22	
		(CH) fat CLAY, trace sand and chert, tan to reddish brown, moist, stiff to very stiff	SPT 3	80	3-5-9 (14)	4.0	25				3.0'-5.0': Bulk sample
			SPT 4	77	3-7-9 (16)	4.5+	28				

Refusal at 8.9 feet.
Bottom of borehole at 8.9 feet.

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/17/26COMPLETED 3/17/26GROUND ELEVATION 886 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		CRUSHED STONE AGGREGATE (5.5 INCHES)	SPT 1	63	3-2-2 (4)	2.0	15				
		(CL) lean CLAY, brown to light brown with gray mottle, moist, medium stiff to very stiff	SPT 2	87	2-4-6 (10)	2.5	21	42	18	24	
5			ST 1	55		3.0	22				Qu = 4,795 psf
		(CH) fat CLAY, light brown with gray mottle, moist, very stiff to very soft	SPT 3	100	5-7-10 (17)	4.5+	31				
10			SPT 4	100	4-6-8 (14)	4.25	28				
15			SPT 5	100	4-5-6 (11)	3.5	31				
20			SPT 6	7	0-0-0 (0)	1.0	30				

Refusal at 21.1 feet.
Bottom of borehole at 21.1 feet.



CLIENT Cooperative Building Solutions PROJECT NAME Taylor County RECC
PROJECT NUMBER 225-370 PROJECT LOCATION Campbellsville, KY
DATE STARTED 3/17/26 COMPLETED 3/17/26 GROUND ELEVATION 873.5 ft
DRILLING CONTRACTOR Adam Thompson GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Augers AT TIME OF DRILLING --- Dry
LOGGED BY Jennifer Kirk CHECKED BY Dylan Elmore AT END OF DRILLING ---
NOTES AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		CRUSHED STONE AGGREGATE (4.5 INCHES) (CL) lean CLAY, trace sand and chert, reddish brown, moist, medium stiff to very stiff	SPT 1	60	2-2-4 (6)	2.25	19				
			SPT 2	63	3-4-6 (10)	2.5	27				
5			SPT 3	97	3-4-7 (11)	2.5	28				
			SPT 4	63	4-5-9 (14)	4.0	17				
10			SPT 5	80	5-8-10 (18)	3.5	19				

Bottom of borehole at 10.5 feet.

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/17/26COMPLETED 3/17/26GROUND ELEVATION 876 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL (8 INCHES)									
		(CL) lean CLAY, trace sand, brown to reddish brown with light brown mottle, moist, medium stiff	SPT 1	87	1-3-4 (7)	2.5	21				
		(CH) fat CLAY, trace sand, reddish brown with light brown mottle, moist, very stiff	SPT 2	80	4-7-9 (16)	4.5+	26	51	22	29	
			ST 1	75		2.5	30				Qu = 7,725 psf
5											
			SPT 3	90	4-6-10 (16)	4.25	29				
10			SPT 4	100	3-6-8 (14)	4.0	27				
Refusal at 12.0 feet. Bottom of borehole at 12.0 feet.											



CLIENT Cooperative Building Solutions **PROJECT NAME** Taylor County RECC
PROJECT NUMBER 225-370 **PROJECT LOCATION** Campbellsville, KY
DATE STARTED 3/17/26 **COMPLETED** 3/17/26 **GROUND ELEVATION** 883.5 ft
DRILLING CONTRACTOR Adam Thompson **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Augers **AT TIME OF DRILLING** --- Dry
LOGGED BY Jennifer Kirk **CHECKED BY** Dylan Elmore **AT END OF DRILLING** ---
NOTES --- **AFTER DRILLING** ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		CRUSHED STONE AGGREGATE (9.5 INCHES)	SPT 1	77	6-4-2 (6)	2.25	19				
		(CL) lean CLAY, trace sand, tan to reddish brown, moist, medium stiff to stiff	SPT 2	57	2-3-6 (9)	3.25	31				
5		(CH) fat CLAY, trace sand, reddish brown, moist, stiff to very stiff	SPT 3	80	2-4-5 (9)	2.5	29				
			SPT 4	80	3-6-8 (14)	2.75	27				
10			SPT 5	77	4-7-10 (17)	4.25	24				

Bottom of borehole at 10.5 feet.

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/12/26COMPLETED 3/12/26GROUND ELEVATION 893.5 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		CRUSHED STONE AGGREGATE (5 INCHES)	SPT 1	93	3-3-2 (5)	1.25	20				
		(CL) lean CLAY, trace sand, light brown to reddish brown with black and gray mottle, moist, medium stiff	SPT 2	100	3-2-3 (5)	1.25	20	34	16	18	
5			ST 1	75		1.75	20				Qu = 1,990 psf
		(CH) fat CLAY, trace sand, reddish brown with black and gray mottle, moist, stiff to very stiff	SPT 3	100	3-4-7 (11)	3.0	27				
10			SPT 4	100	4-7-9 (16)	3.75	25				

Refusal at 13.8 feet.
Bottom of borehole at 13.8 feet.



CLIENT Cooperative Building Solutions **PROJECT NAME** Taylor County RECC
PROJECT NUMBER 225-370 **PROJECT LOCATION** Campbellsville, KY
DATE STARTED 3/12/26 **COMPLETED** 3/12/26 **GROUND ELEVATION** 893 ft
DRILLING CONTRACTOR Adam Thompson **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Augers **AT TIME OF DRILLING** --- Dry
LOGGED BY Jennifer Kirk **CHECKED BY** Dylan Elmore **AT END OF DRILLING** ---
NOTES --- **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		CRUSHED STONE AGGREGATE (6 INCHES)	SPT 1	87	4-3-3 (6)	2.0	30				
		(CL) lean CLAY, trace sand and chert, brown with reddish brown and black mottle, moist, medium stiff	SPT 2	80	2-3-5 (8)	1.75	32				
5		(CH) fat CLAY, trace sand and chert, brown with reddish brown and black mottle, wet, stiff	SPT 3	100	2-50	0.75	39				
		SHALE, very fine grained, tan and gray, laminated, soft, highly weathered									
		Refusal at 5.0 feet. Bottom of borehole at 5.0 feet.									

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/16/26COMPLETED 3/16/26GROUND ELEVATION 892 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD HSA/ Diamond impregnated coring bitAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 4/14/26 15:40 - I:\GLASGOW-T125 PROJECTS\225-370 TAYLOR COUNTY RECC\GEOTECH\LAB\TREC.C.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		ASPHALT (2.5 INCHES)									
		CRUSHED STONE AGGREGATE (6 INCHES)									
		(CL) lean CLAY, trace sand, tan with black mottle, moist, medium stiff	SPT 1	87	2-3-3 (6)	2.25	33				
		(CH) fat CLAY, trace sand, tan with black mottle, moist, medium stiff	ST 1	100		2.75	21	59	24	35	Insufficient sample for unconfined compressive strength test.
5		LIMESTONE, fine grained, gray to dark gray, thick bedded, hard, arenaceous	RC 1	100 (92)							4.8'-4.9': Highly fractured

Refusal at 3.5 feet.
Bottom of borehole at 8.5 feet.



CLIENT	Cooperative Building Solutions	PROJECT NAME	Taylor County RECC
PROJECT NUMBER	225-370	PROJECT LOCATION	Campbellsville, KY
DATE STARTED	3/12/26	COMPLETED	3/12/26
DRILLING CONTRACTOR	Adam Thompson	GROUND ELEVATION	893.5 ft
DRILLING METHOD	Hollow Stem Augers	GROUND WATER LEVELS:	
LOGGED BY	Jennifer Kirk	AT TIME OF DRILLING	--- Dry
CHECKED BY	Dylan Elmore	AT END OF DRILLING	---
NOTES		AFTER DRILLING	---

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 4/14/26 15:40 - I:\GLASGOW-T125 PROJECTS\225-370 TAYLOR COUNTY RECC\GEOTECH\LAB\TREC.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		TOPSOIL (2.5 INCHES)	SPT 1	100	2-3-4 (7)	2.25	18				
		(CL) lean CLAY, trace sand, brown to reddish brown with gray and black mottle, moist, medium stiff to stiff	SPT 2	100	5-7-10 (17)	2.75	18	25	16	9	2.0'-4.0': Bulk sample
5		(CH) fat CLAY, light brown, moist, stiff to medium stiff	SPT 3	100	4-7-8 (15)	4.0	30				
			SPT 4	100	4-4-6 (10)	2.5	28				
10			SPT 5	100	2-3-2 (5)	1.75	33				

Bottom of borehole at 10.5 feet.

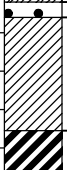
CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/12/26COMPLETED 3/12/26GROUND ELEVATION 890 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0											
		ASPHALT (2.5 INCHES) CRUSHED STONE AGGREGATE (5 INCHES) (CL) lean CLAY, trace sand, orange-brown with tan and black mottle, moist, medium stiff to stiff (CH) fat CLAY, light brown, moist, stiff	SPT 1	97	2-3-4 (7)	2.25	28				4.0'-4.7': Insufficient sample for unconfined compressive strength test.
			SPT 2	87	3-5-5 (10)	2.25	34				
			ST 1	100		2.0	15				4.7': Shale at bottom of ST
		Refusal at 4.7 feet. Bottom of borehole at 4.7 feet.									

CLIENT Cooperative Building SolutionsPROJECT NAME Taylor County RECCPROJECT NUMBER 225-370PROJECT LOCATION Campbellsville, KYDATE STARTED 3/17/26COMPLETED 3/17/26GROUND ELEVATION 873.5 ftDRILLING CONTRACTOR Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem AugersAT TIME OF DRILLING --- DryLOGGED BY Jennifer KirkCHECKED BY Dylan ElmoreAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL (31 INCHES)	SPT 1	70	2-3-3 (6)	2.5	18				
			SPT 2	83	4-4-6 (10)	3.5	26				
		(CL) lean CLAY, trace sand, reddish brown with tan mottle, moist, medium stiff to stiff									
5		(CH) fat CLAY, trace sand, reddish brown with tan mottle, moist, very stiff	ST 1	50		4.0	27				Qu = 7,565 psf
			SPT 3	100	4-7-8 (15)	3.5	31				
10			SPT 4	100	4-6-9 (15)	4.5+	36				

Refusal at 12.8 feet.
Bottom of borehole at 12.8 feet.



CLIENT

Cooperative Building Solutions

PROJECT NAME

Taylor County RECC

PROJECT NUMBER

225-370

PROJECT LOCATION

Campbellsville, KY

DATE STARTED

3/18/26

COMPLETED

3/18/26

GROUND ELEVATION

882 ft

DRILLING CONTRACTOR

Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD

Hollow Stem Augers

AT TIME OF DRILLING

--- Dry

LOGGED BY

Jennifer Kirk

CHECKED BY

Dylan Elmore

AT END OF DRILLING

NOTES

AFTER DRILLING

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		CRUSHED STONE AGGREGATE (8 INCHES) (CL) lean CLAY, trace sand, tan to orange-brown with reddish brown mottle, moist, medium stiff to very stiff	SPT 1	73	5-4-2 (6)	2.75	18				
			SPT 2	37	1-2-2 (4)	2.0	32				
5			SPT 3	83	3-6-9 (15)	4.0	24				
10		(CH) fat CLAY, trace sand and chert, reddish brown, moist, stiff	SPT 4	100	4-6-7 (13)	3.25	31	58	23	35	6.0'-10.0': Bulk sample Qu = 3,720 psf
			ST 1	100		4.5+	30				
15			SPT 5	100	3-4-5 (9)	3.0	33				
			SPT 6	77	2-1-50 (51)	1.75	30				19.8': Trace sandy limestone fragments

Refusal at 19.8 feet.
Bottom of borehole at 19.8 feet.



APPENDIX C

Laboratory Testing Results

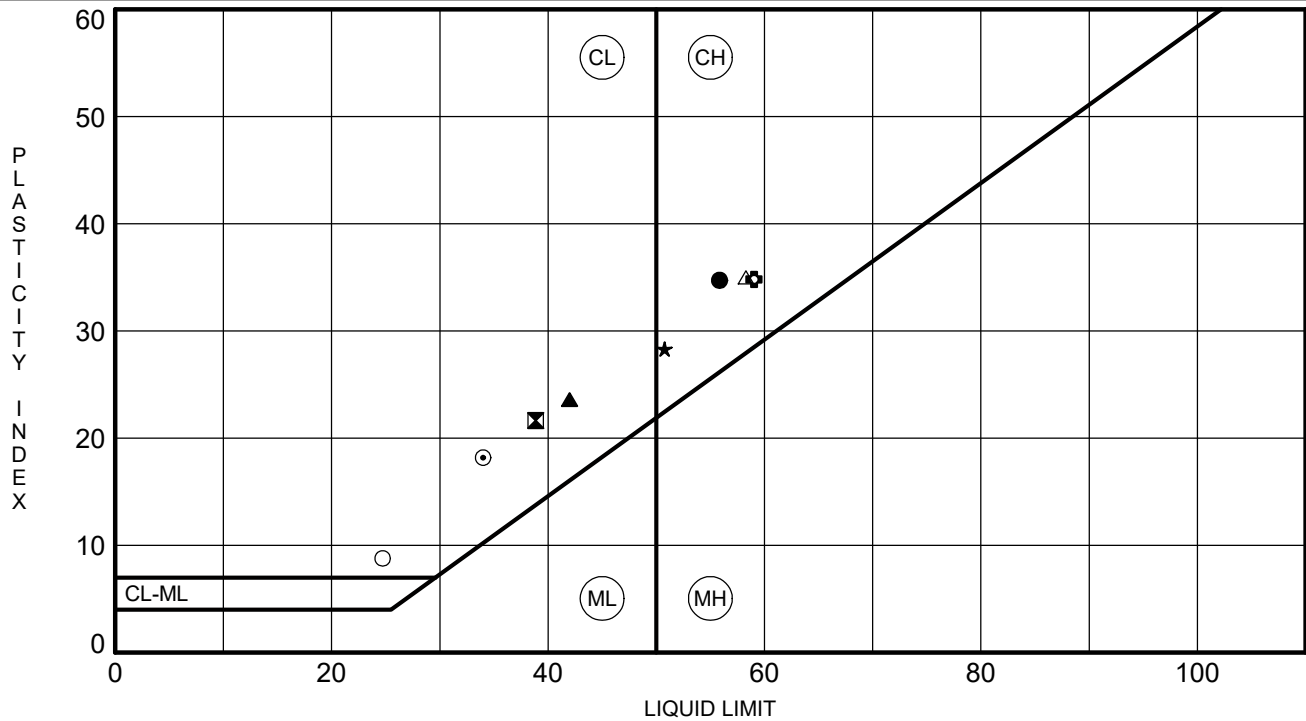
ATTERBERG LIMITS' RESULTS

CLIENT Cooperative Building Solutions

PROJECT NAME Taylor County RECC

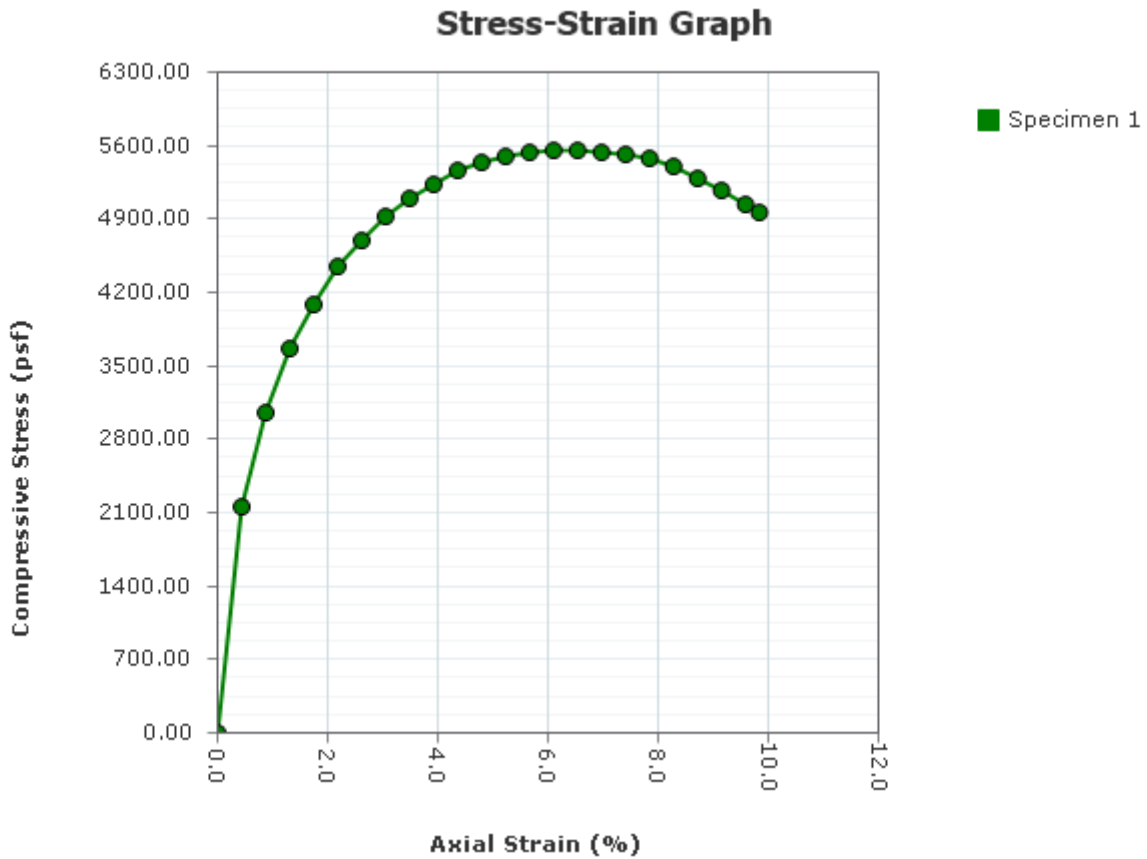
PROJECT NUMBER 225-370

PROJECT LOCATION Campbellsville, KY

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Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 6.5 ft - 8.5 ft
Boring Number: B-1
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC

		Specimen Number							
	Before Test	1	2	3	4	5	6	7	8
	Moisture Content (%):	21.9							
	Wet Density (pcf)	129.0							
	Dry Density (pcf)	105.8							
	Saturation (%):	98.4							
	Void Ratio:	0.604							
	Height (in)	5.7380							
	Diameter (in)	2.8650							
	Strain Limit @ 15% (in)	0.9							
	Height To Diameter Ratio:	2.00							
	Test Data	1	2	3	4	5	6	7	8
	Failure Angle (°):	0							
	Strain Rate (in/min)	0.09812							
	Strain Rate (%/min):	1.71							
	Unconfined Compressive Strength (psf)	5524.36							
	Undrained Shear Strength (psf)	2762.18							
	Strain at Failure (%):	7.41							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	6.5 ft - 8.5 ft
Boring Number:	B-1
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Project Name: Taylor County RECC Project Number: 225-370

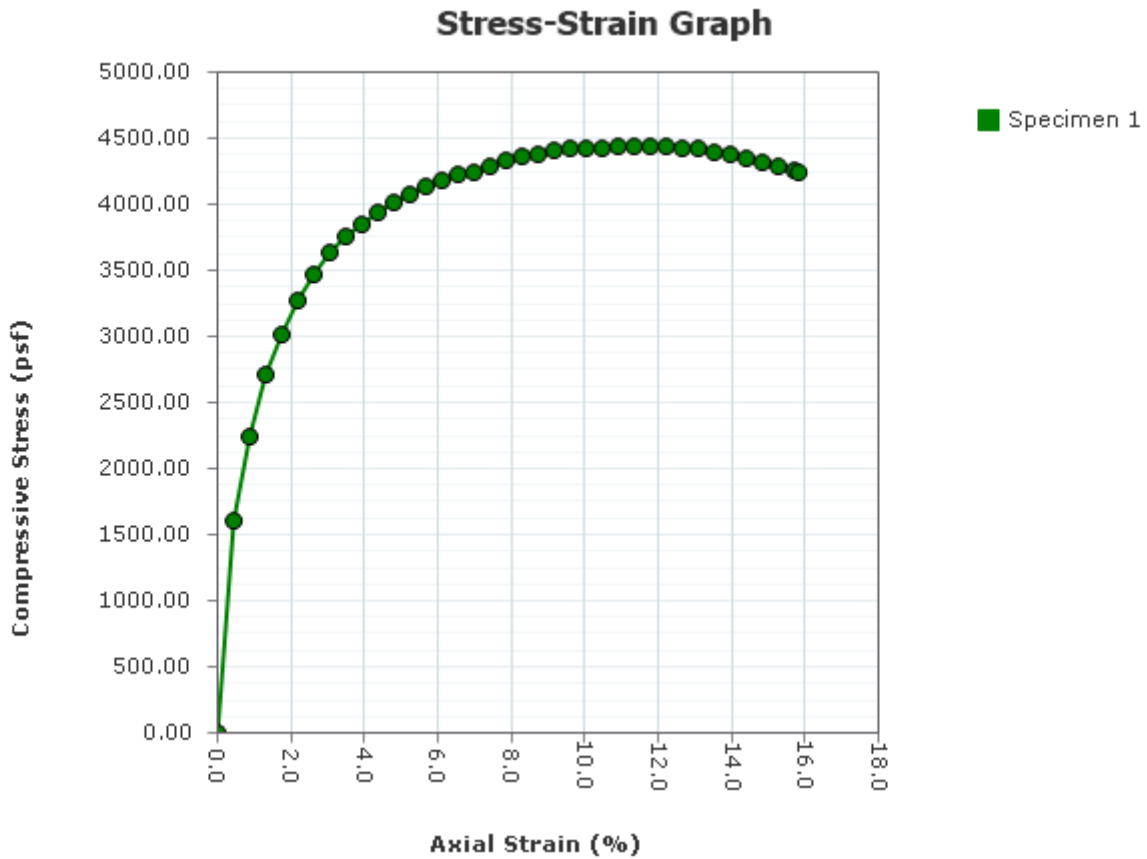
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 2.5 ft - 4.5 ft
Boring Number: B-2
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC

	Specimen Number								
	Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	26.4								
Wet Density (pcf)	123.2								
Dry Density (pcf)	97.5								
Saturation (%):	96.8								
Void Ratio:	0.742								
Height (in)	5.7300								
Diameter (in)	2.7860								
Strain Limit @ 15% (in)	0.9								
Height To Diameter Ratio:	2.06								
	Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0								
Strain Rate (in/min)	0.097983								
Strain Rate (%/min):	1.71								
Unconfined Compressive Strength (psf)	4399.98								
Undrained Shear Strength (psf)	2199.99								
Strain at Failure (%):	13.53								

Specific Gravity:	2.72	Plastic Limit:	21	Liquid Limit:	56
Type:	UD	Soil Classification:	CH		

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	2.5 ft - 4.5 ft
Boring Number:	B-2
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch

Project Name: Taylor County RECC Project Number: 225-370

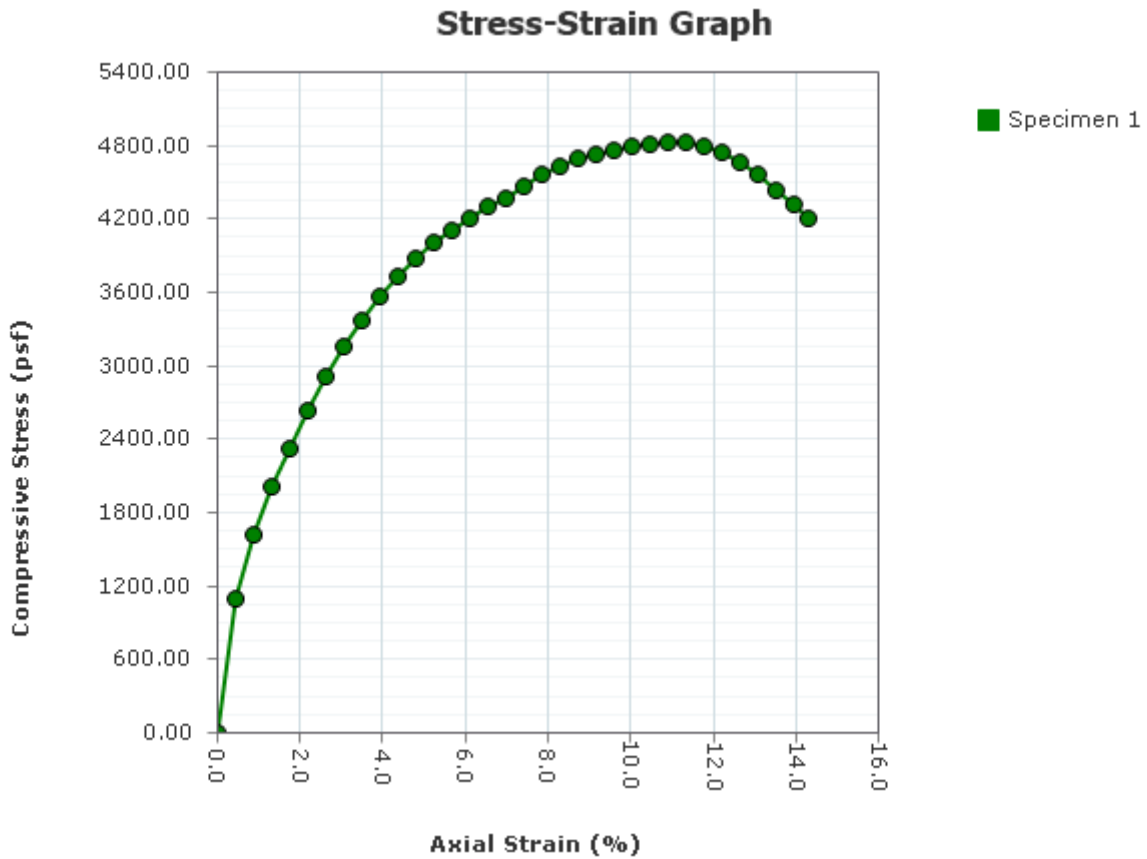
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 4.0 ft - 6.0 ft
Boring Number: B-3
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC

	Specimen Number								
	Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	23.0								
Wet Density (pcf)	128.2								
Dry Density (pcf)	104.2								
Saturation (%):	99.3								
Void Ratio:	0.629								
Height (in)	5.7330								
Diameter (in)	2.7580								
Strain Limit @ 15% (in)	0.9								
Height To Diameter Ratio:	2.08								
	Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0								
Strain Rate (in/min)	0.098034								
Strain Rate (%/min):	1.71								
Unconfined Compressive Strength (psf)	4796.21								
Undrained Shear Strength (psf)	2398.11								
Strain at Failure (%):	11.77								

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	4.0 ft - 6.0 ft
Boring Number:	B-3
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Project Name: Taylor County RECC Project Number: 225-370

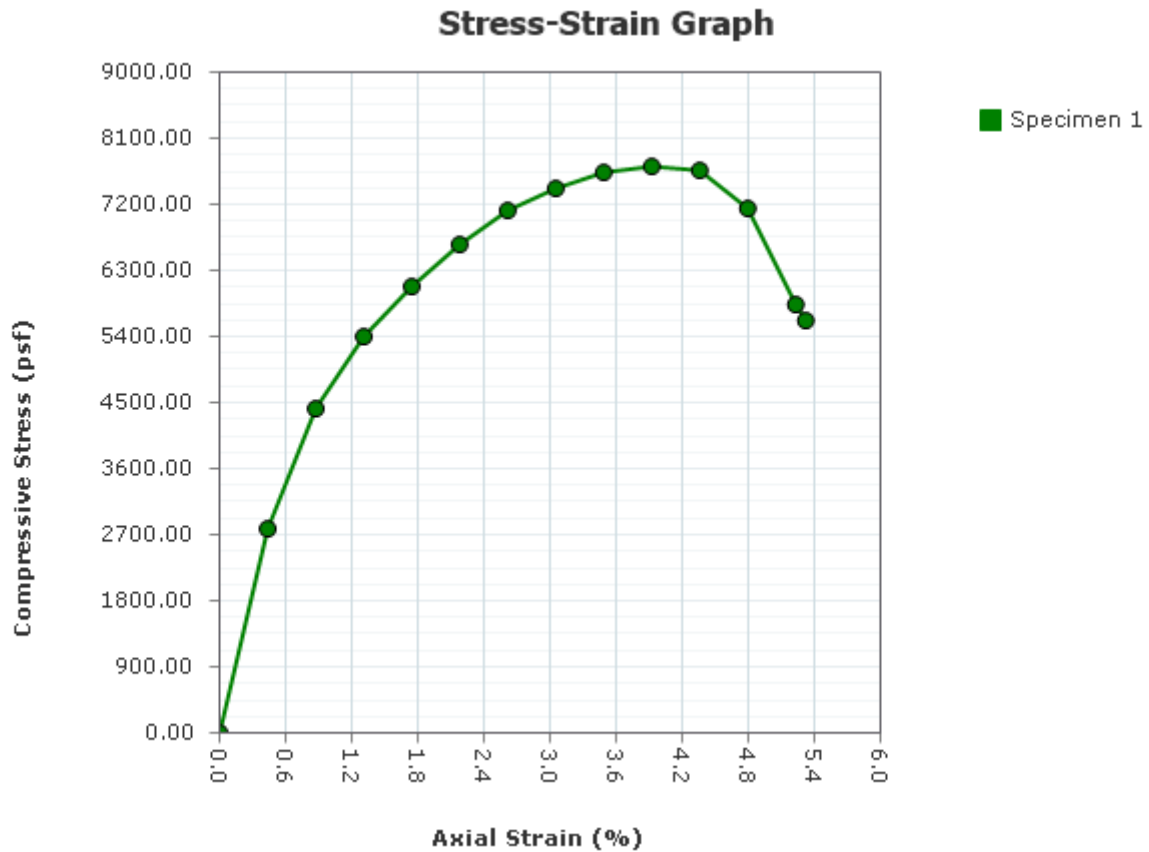
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 3.0 ft - 5.0 ft
Boring Number: B-4
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

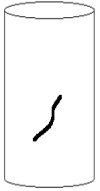
Unconfined Compression Test

UNC

	Specimen Number								
	Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	27.0								
Wet Density (pcf)	123.7								
Dry Density (pcf)	97.4								
Saturation (%):	98.8								
Void Ratio:	0.744								
Height (in)	5.7360								
Diameter (in)	2.8620								
Strain Limit @ 15% (in)	0.9								
Height To Diameter Ratio:	2.00								
Test Data	1	2	3	4	5	6	7	8	
Failure Angle (°):	0								
Strain Rate (in/min)	0.098086								
Strain Rate (%/min):	1.71								
Unconfined Compressive Strength (psf)	7726.45								
Undrained Shear Strength (psf)	3863.22								
Strain at Failure (%):	3.92								

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	3.0 ft - 5.0 ft
Boring Number:	B-4
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Project Name: Taylor County RECC Project Number: 225-370

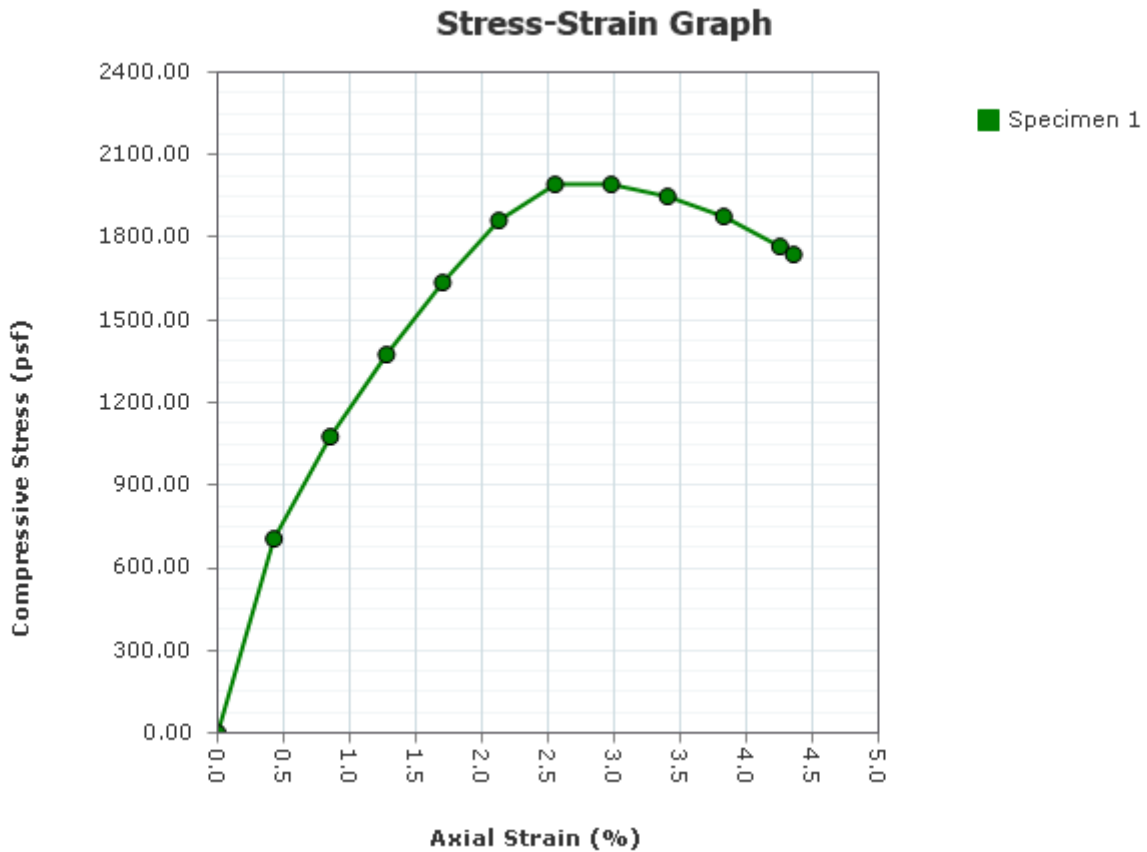
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 3.0 ft - 5.0 ft
Boring Number: B-5
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

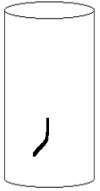
Unconfined Compression Test

UNC

	Specimen Number								
	Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	17.9								
Wet Density (pcf)	134.1								
Dry Density (pcf)	113.7								
Saturation (%):	98.9								
Void Ratio:	0.493								
Height (in)	5.8770								
Diameter (in)	2.7560								
Strain Limit @ 15% (in)	0.9								
Height To Diameter Ratio:	2.13								
	Test Data	1	2	3	4	5	6	7	8
Failure Angle (°):	0								
Strain Rate (in/min)	0.097932								
Strain Rate (%/min):	1.67								
Unconfined Compressive Strength (psf)	1991.92								
Undrained Shear Strength (psf)	995.96								
Strain at Failure (%):	2.98								

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	3.0 ft - 5.0 ft
Boring Number:	B-5
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Project Name: Taylor County RECC Project Number: 225-370

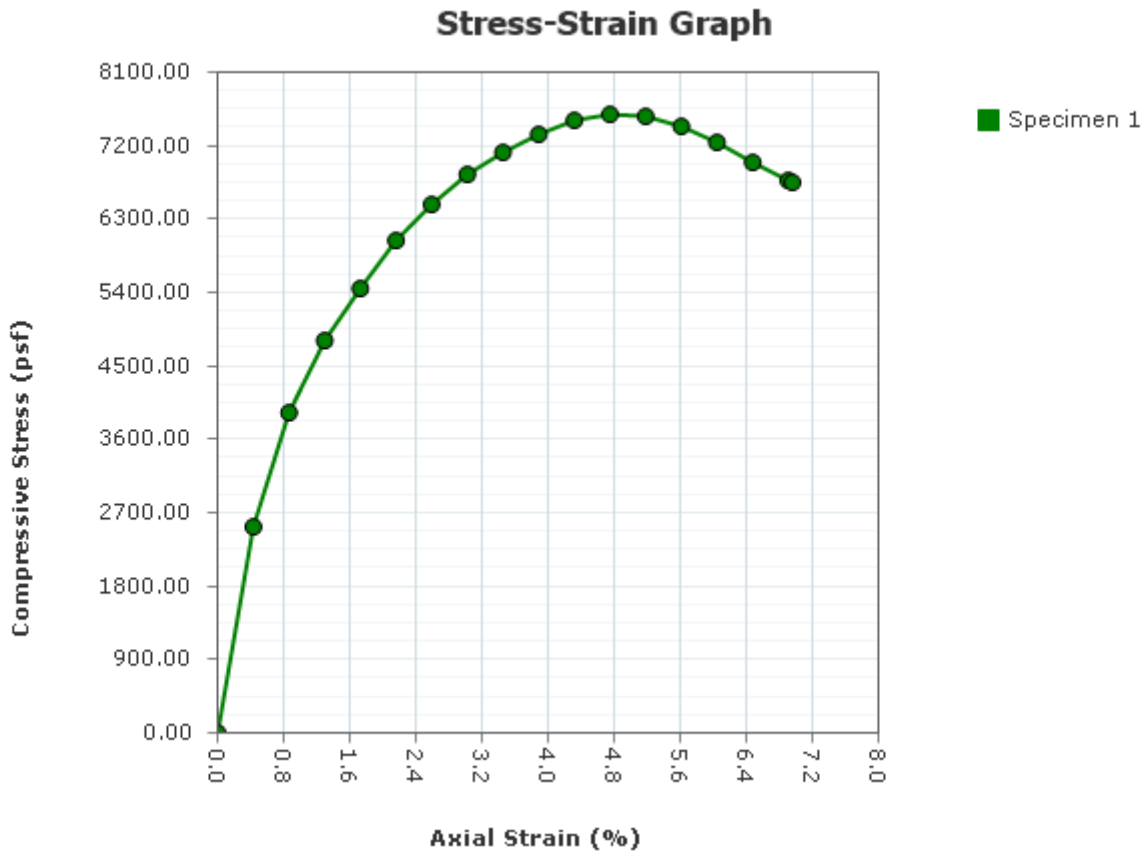
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 4.0 ft - 6.0 ft
Boring Number: B-8
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

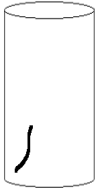
Unconfined Compression Test

UNC

	Specimen Number								
	Before Test	1	2	3	4	5	6	7	8
Moisture Content (%):	28.3								
Wet Density (pcf)	122.5								
Dry Density (pcf)	95.5								
Saturation (%):	98.9								
Void Ratio:	0.778								
Height (in)	5.7910								
Diameter (in)	2.7360								
Strain Limit @ 15% (in)	0.9								
Height To Diameter Ratio:	2.12								
Test Data	1	2	3	4	5	6	7	8	
Failure Angle (°):	0								
Strain Rate (in/min)	0.097316								
Strain Rate (%/min):	1.68								
Unconfined Compressive Strength (psf)	7568.38								
Undrained Shear Strength (psf)	3784.19								
Strain at Failure (%):	5.18								

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	4.0 ft - 6.0 ft
Boring Number:	B-8
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Project Name: Taylor County RECC Project Number: 225-370

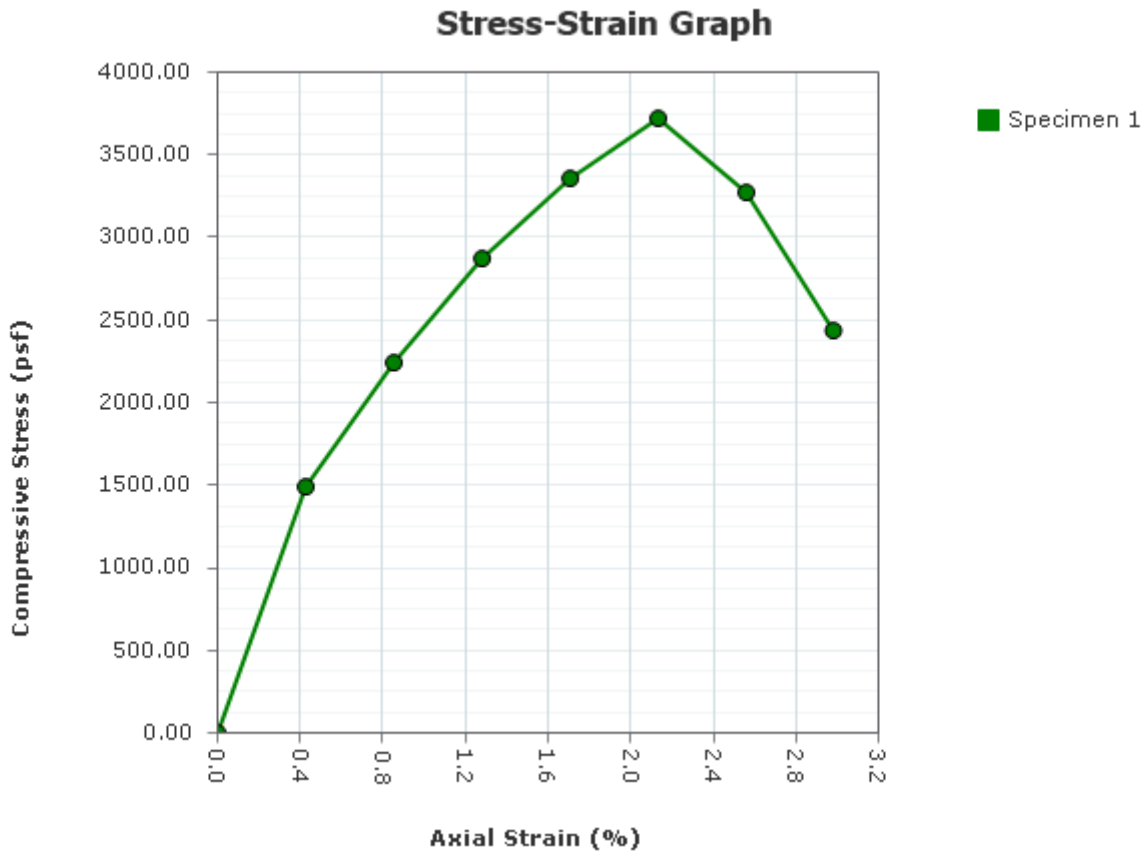
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

Unconfined Compression Test

UNC



Project: Taylor County RECC
Project Number: 225-370
Received Date: 4/2/2026
Sampling Date: 4/2/2026
Sample Number: ST-1
Sample Depth: 8.0 ft - 10.0 ft
Boring Number: B-9
Location: Campbellsville, KY
Client Name: Cooperative Building Solutions
Remarks:

Project Name: Taylor County RECC Project Number: 225-370

Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

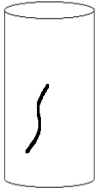
Unconfined Compression Test

UNC

		Specimen Number							
	Before Test	1	2	3	4	5	6	7	8
	Moisture Content (%):	29.8							
	Wet Density (pcf)	120.4							
	Dry Density (pcf)	92.8							
	Saturation (%):	97.7							
	Void Ratio:	0.830							
	Height (in)	5.8610							
	Diameter (in)	2.8540							
	Strain Limit @ 15% (in)	0.9							
	Height To Diameter Ratio:	2.05							
	Test Data	1	2	3	4	5	6	7	8
	Failure Angle (°):	0							
	Strain Rate (in/min)	0.098513							
	Strain Rate (%/min):	1.68							
	Unconfined Compressive Strength (psf)	3721.58							
	Undrained Shear Strength (psf)	1860.79							
	Strain at Failure (%):	2.13							

Specific Gravity:	2.72	Plastic Limit:	0	Liquid Limit:	0
Type:	UD	Soil Classification:			

Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	4/2/2026
Sample Number:	ST-1
Sample Depth:	8.0 ft - 10.0 ft
Boring Number:	B-9
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Specimen 1 Failure Sketch	Specimen 2 Failure Sketch	Specimen 3 Failure Sketch	Specimen 4 Failure Sketch	Specimen 5 Failure Sketch	Specimen 6 Failure Sketch	Specimen 7 Failure Sketch	Specimen 8 Failure Sketch
							

Project Name: Taylor County RECC Project Number: 225-370

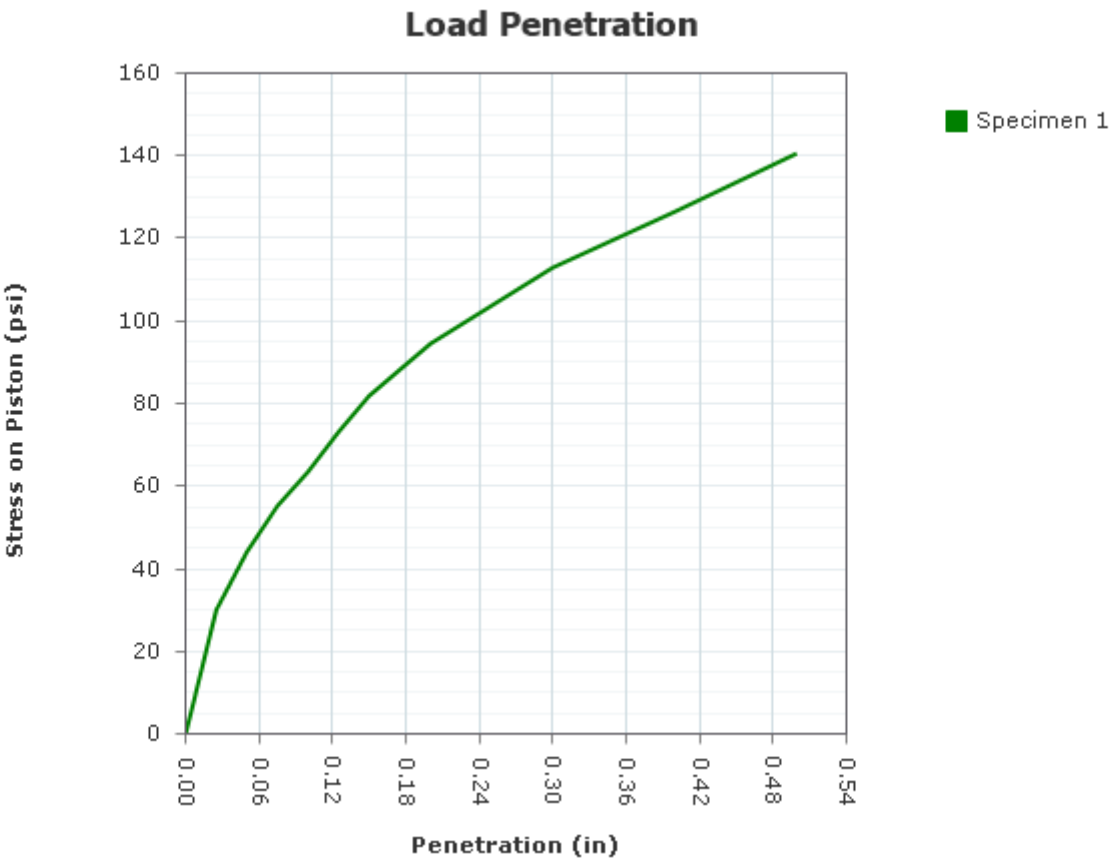
Test Date: 4/2/2026

Checked By: _____ Date: _____

Report Created: 4/9/2026

CBR Test Results

ASTM (D1883) / AASHTO (T193)



CBR Results								
Results	1	2	3	4	5	6	7	8
CBR @ 0.10 (in)	6.4							
CBR @ 0.20 (in)	6.3							

Project Information	
Project:	Taylor County RECC
Project Number:	225-370
Sampling Date:	
Sample Number:	BS-1
Sample Depth:	2.0 ft - 4.0 ft
Location:	Campbellsville, KY
Client Name:	Cooperative Building Solutions
Remarks:	

Project Name: Taylor County RECC Project Number: 225-370

Tested By: _____

Date: _____

Checked By: _____

Date: _____

CBR Test

ASTM (D1883) / AASHTO (T193)

Before Soaking	1	2	3	4	5	6	7	8
Specific Gravity	2.72							
Liquid Limit	25							
Plastic Limit	9							
Surcharge Weight (lb)	12.60							
Number of Blows	33							
Maximum Dry Density (pcf)	114.3							
Optimum Moisture Content (%)	14.9							
Mold ID	HC							
Mold Diameter (in)	6.000							
Mold Weight (lb)	17.59							
Sample Height (in)	4.584							
Mold Volume (in³)	129.61							
Moisture Content (%)	15.4							
Weight of Mold + Soil (lb)	27.01							
Weight of Soil (lb)	9.42							
Dry Density (pcf)	108.8							
Wet Density (pcf)	125.5							
After Soaking	1	2	3	4	5	6	7	8
Soaked Sample Height (in)	4.588							
Soaked Time (Day)	5.0							
Swell (%)	0.1							
Moisture Content (%)	17.3							
Weight of Mold + Soil (lb)	27.16							
Weight After Soaking (lb)	9.57							
Dry Density (pcf)	108.8							
Wet Density (pcf)	127.6							
Piston Area (in²)	0.000							

Project Name: Taylor County RECC Project Number: 225-370

Tested By: _____

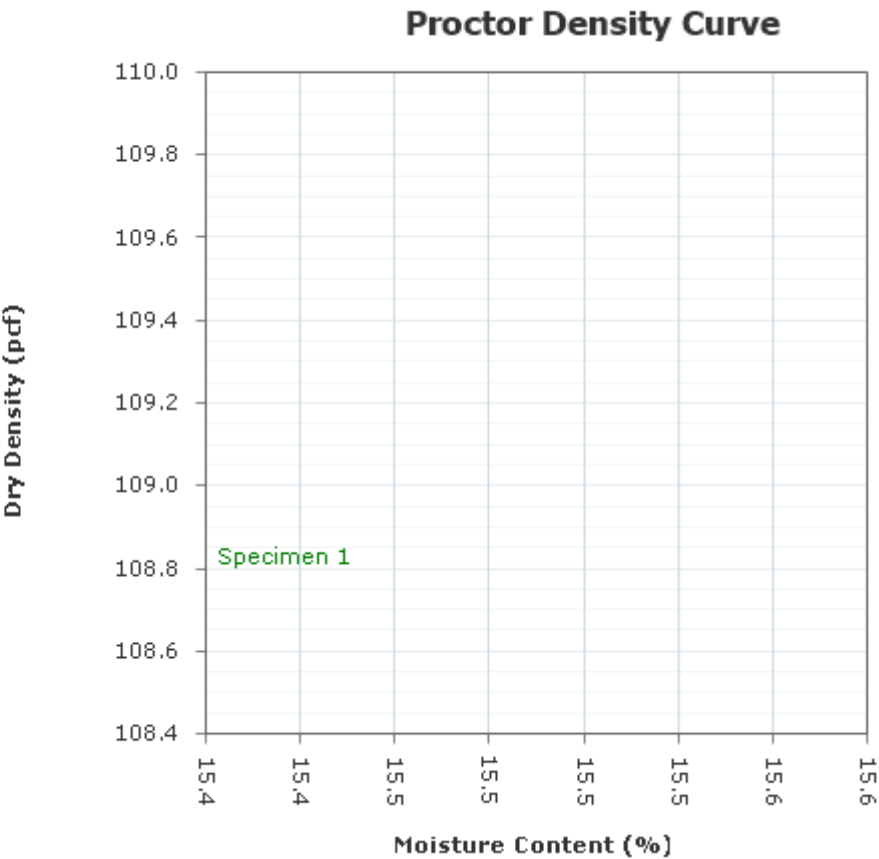
Date: _____

Checked By: _____

Date: _____

CBR Proctor Density Curve

ASTM (D1883) / AASHTO (T193)



CBR Proctor Density Curve	
Maximum Dry Density (pcf)	108.8
Optimum Moisture Content (%)	15.4

Tested By: _____

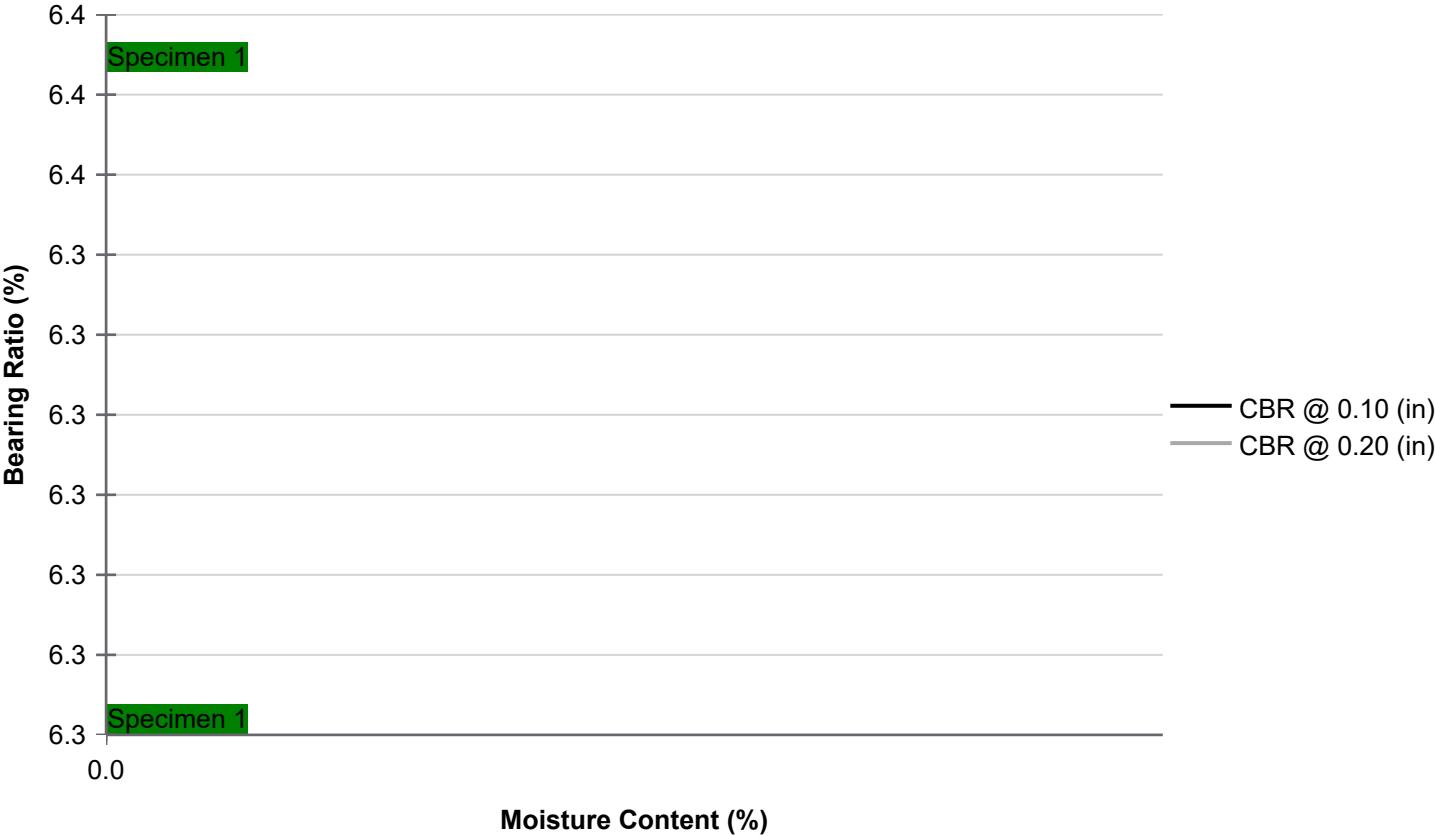
Date: _____

Checked By: _____

Date: _____

CBR Bearing Ratio

ASTM (D1883) / AASHTO (T193)

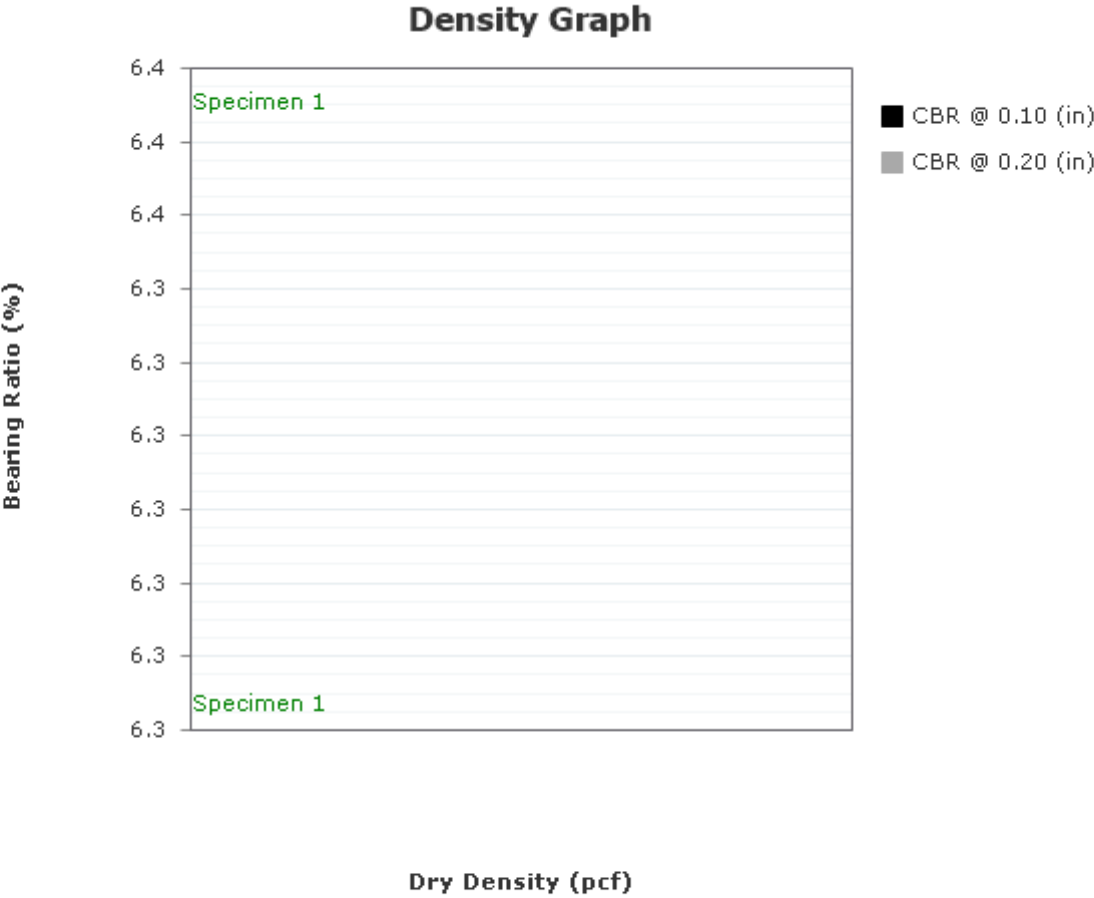


CBR Results	
CBR @ 0.10 (in)	6.4
CBR @ 0.20 (in)	6.3
Moisture Content (%)	15.4

Tested By: _____ Date: _____ Project Name: Taylor County RECC Project Number: 225-370 Checked By: _____ Date: _____

CBR Density Graph

ASTM (D1883) / AASHTO (T193)



CBR Results	
CBR @ 0.10 (in)	6.4
CBR @ 0.20 (in)	6.3
Maximum Dry Density (pcf)	108.8

CBR Test - Specimen 1

ASTM (D1883) / AASHTO (T193)

Index	Elapsed Time (hh:mm:ss)	Load (Lbf)	Displacement (in)	Corrected Load (Lbf)	Corrected Penetration (in)	Stress On Piston (psi)	CBR (%)	Corrected CBR (%)
0	00:00:00	2.8	0.001	0.0	0.00	0	0.0	0.0
1	00:00:33	93.6	0.026	90.8	0.03	30	0.0	0.0
2	00:01:05	134.9	0.051	132.0	0.05	44	0.0	0.0
3	00:01:39	168.1	0.076	165.2	0.08	55	0.0	0.0
4	00:02:11	193.7	0.101	190.8	0.10	64	6.4	6.4
5	00:02:49	222.4	0.126	219.6	0.13	73	0.0	0.0
6	00:03:28	248.1	0.151	245.2	0.15	82	0.0	0.0
7	00:04:02	267.7	0.176	264.8	0.18	88	0.0	0.0
8	00:04:38	286.2	0.201	283.3	0.20	94	6.3	6.3
9	00:06:49	341.2	0.301	338.4	0.30	113	5.9	5.9
10	00:08:44	382.7	0.401	379.9	0.40	127	5.5	5.5
11	00:11:06	424.5	0.500	421.6	0.50	141	5.4	5.4

Project Name: Taylor County RECC Project Number: 225-370

Tested By: _____

Date: _____

Checked By: _____

Date: _____



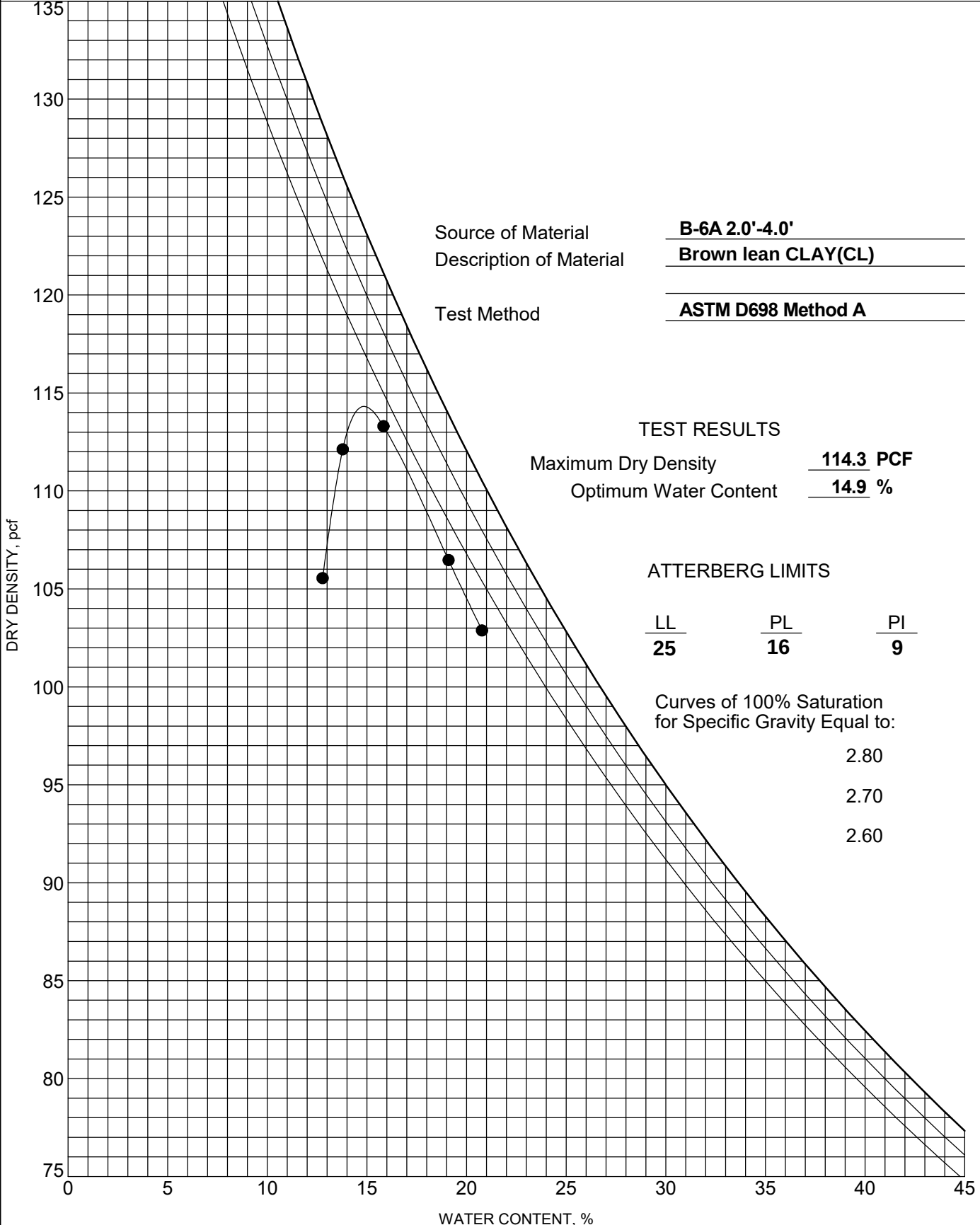
MOISTURE-DENSITY RELATIONSHIP

CLIENT Cooperative Building Solutions

PROJECT NAME Taylor County RECC

PROJECT NUMBER 225-370

PROJECT LOCATION Campbellsville, KY





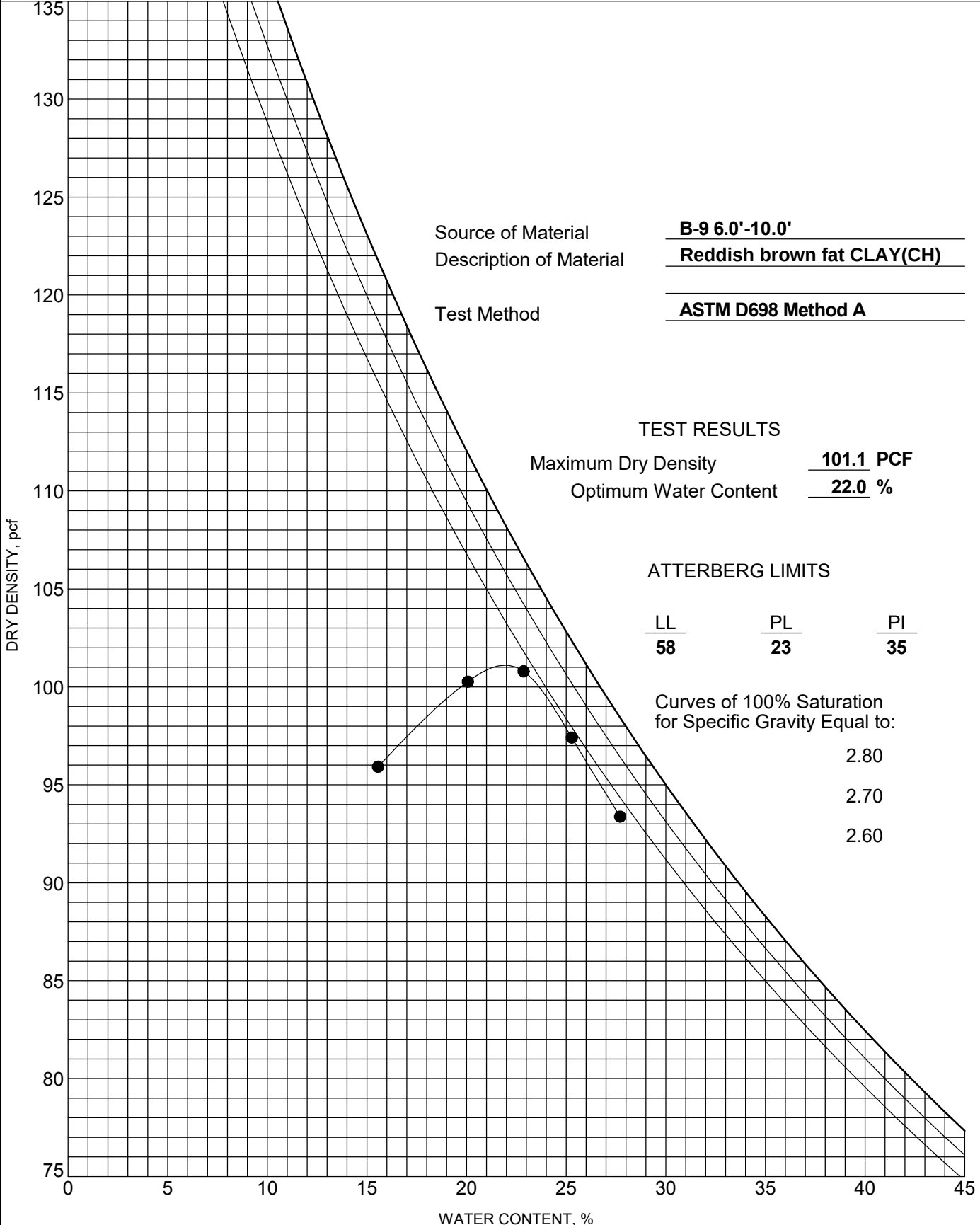
MOISTURE-DENSITY RELATIONSHIP

CLIENT Cooperative Building Solutions

PROJECT NAME Taylor County RECC

PROJECT NUMBER 225-370

PROJECT LOCATION Campbellsville, KY





Client: Cooperative Building Solutions, LLC
Project No.: 225-370
Date: 3/30/2026

Project Name: Taylor County RECC
Project Location: Campbellsville, KY

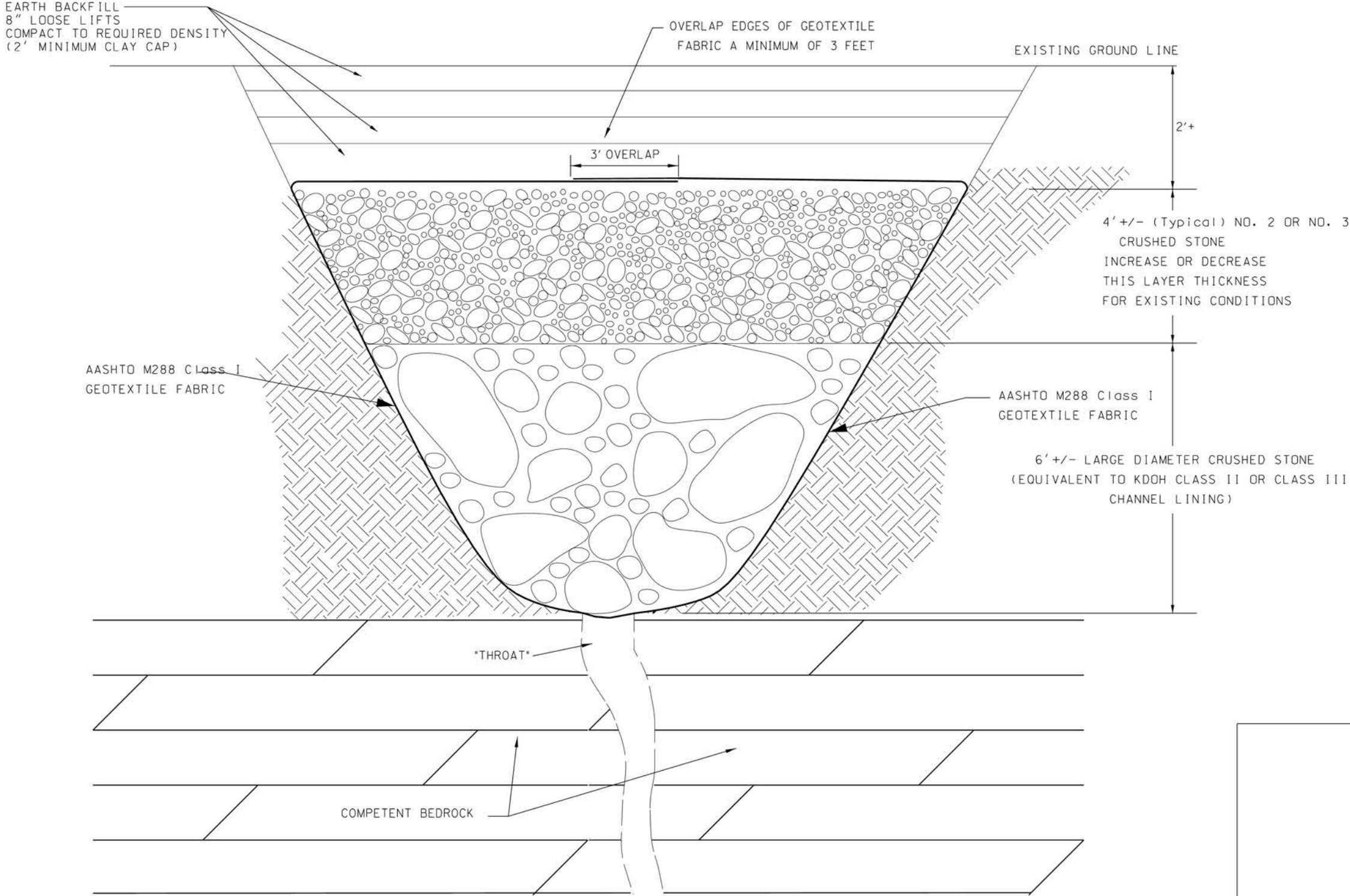
Hole #	Depth (ft)	Diameter (in)	Height (in)	Weight (g)	Load	Strength (psi)	L/D Ratio	Density (pcf)
B-1A	10.5-10.8	1.97	4.02	530.7	28,890	9,512	2.0	165.5
B-1A	12.9-13.2	1.96	4.16	529.5	26,790	8,857	2.1	160.5
B-1A	15.0-15.3	1.96	4.12	538.0	38,980	12,900	2.1	164.5
B-6A	3.7-4.0	1.95	3.97	496.6	22,850	7,624	2.0	159.0
B-6A	6.7-7.0	1.95	4.16	500.4	26,130	8,727	2.1	153.1
B-6A	8.0-8.3	1.96	4.10	464.4	11,850	3,938	2.1	143.4



APPENDIX D

Typical Sinkhole Treatment Detail

TYPICAL SINKHOLE TREATMENT DETAIL



NOT TO SCALE

Your Geotechnical Engineering Report

To help manage your risks, this information is being provided because subsurface issues are a major cause of construction delays, cost overruns, disputes, and claims.

Geotechnical Services are Performed for Specific Projects, Purposes, and People

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering exploration conducted for an engineer may not fulfill the needs of a contractor or even another engineer. Each geotechnical engineering exploration and report is unique and is prepared solely for the client. No one except the client should rely on the geotechnical engineering report without first consulting with the geotechnical engineer who prepared it. The report should not be applied for any project or purpose except the one originally intended.

Read the Entire Report

To avoid serious problems, the full geotechnical engineering report should be read in its entirety. Do not only read selected sections or the executive summary.

A Unique Set of Project-Specific Factors is the Basis for a Geotechnical Engineering Report

Geotechnical engineers consider a numerous unique, project-specific factors when determining the scope of a study. Typical factors include: the client's goals, objectives, project costs, risk management preferences, proposed structures, structures on site, topography, and other proposed or existing site improvements, such as access roads, parking lots, and utilities. Unless indicated otherwise by the geotechnical engineer who conducted the original exploration, a geotechnical engineering report should not be relied upon if it was:

- not prepared for you or your project,
- not prepared for the specific site explored, or
- completed before important changes to the project were implemented.

Typical changes that can lessen the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a multi-story hotel to a parking lot
- finished floor elevation, location, orientation, or weight of the proposed structure, anticipated loads or
- project ownership

Geotechnical engineers cannot be held liable or responsible for issues that occur because their report did not take into account development items of which they were not informed. The geotechnical engineer should always be notified of any project changes. Upon notification, it should be requested of the geotechnical engineer to give an assessment of the impact of the project changes.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that exist at the time of the exploration. A geotechnical engineering report should not be relied upon if its reliability could be in question due to factors such as man-made events as construction on or adjacent to the site, natural events such as floods, earthquakes, or groundwater fluctuation, or time. To determine if a geotechnical report is still reliable, contact the geotechnical engineer. Major problems could be avoided by performing a minimal amount of additional analysis and/or testing.

Most Geotechnical Findings are Professional Opinions

Geotechnical site explorations identify subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field logs and laboratory data and apply their professional judgment to make conclusions about the subsurface conditions throughout the site. Actual subsurface conditions may differ from those indicated in the report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risk associated with unanticipated conditions.



The Recommendations within a Report Are Not Final

Do not put too much faith on the construction recommendations included in the report. The recommendations are not final due to geotechnical engineers developing them principally from judgment and opinion. Only by observing actual subsurface conditions revealed during construction can geotechnical engineers finalize their recommendations. Responsibility and liability cannot be assumed for the recommendations within the report by the geotechnical engineer who developed the report if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject To Misinterpretation

Misinterpretation of geotechnical engineering reports has resulted in costly problems. The risk of misinterpretation can be lowered after the submittal of the final report by having the geotechnical engineer consult with appropriate members of the design team. The geotechnical engineer could also be retained to review crucial parts of the plans and specifications put together by the design team. The geotechnical engineering report can also be misinterpreted by contractors which can result in many problems. By participating in pre-bid and preconstruction meetings and providing construction observations by the geotechnical engineer, many risks can be reduced.

Final Boring Logs should not be re-drawn

Geotechnical engineers prepare final boring logs and testing results based on field logs and laboratory data. The logs included in a final geotechnical engineering report should never be redrawn to be included in architectural or design drawings due to errors that could be made. Electronic reproduction is acceptable, along with photographic reproduction, but it should be understood that separating logs from the report can elevate risk.

Contractors Need a Complete Report and Guidance

By limiting what is provided for bid preparation, contractors

are not liable for unforeseen subsurface conditions although some owners and design professionals believe the opposite to be true. The complete geotechnical engineering report, accompanied with a cover letter or transmittal, should be provided to contractors to help prevent costly problems. The letter states that the report was not prepared for purposes of bid development and the report's accuracy is limited. Although a fee may be required, encourage the contractors to consult with the

geotechnical engineer who prepared the report and/or to conduct additional studies to obtain the specific types of information they need or prefer. A prebid conference involving the owner, geotechnical engineer, and contractors can prove to be very valuable. If needed, allow contractors sufficient time to perform additional studies. Upon doing this you might be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Closely Read Responsibility Provisions

Geotechnical engineering is not as exact as other engineering disciplines. This lack of understanding by clients, design professionals, and contractors has created unrealistic expectations that have led to disappointments, claims, and disputes. To minimize such risks, a variety of explanatory provisions may be included in the report by the geotechnical engineer. To help others recognize their own responsibilities and risks, many of these provisions indicate where the geotechnical engineer's responsibilities begin and end. These provisions should be read carefully, questions asked if needed, and the geotechnical engineer should provide satisfactory responses.

Environmental Issues/Concerns are not Covered

Unforeseen environmental issues can lead to project delays or even failures. Geotechnical engineering reports do not usually include environmental findings, conclusions, or recommendations. As with a geotechnical engineering report, do not rely on an environmental report that was prepared for someone else.



SECTION 011000 - SUMMARY

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 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: this project is for a new headquarters facility for Taylor County RECC. The new buildings on the site consist of a new single story office (20,800 sf), a renovation and addition onto their existing operations building (38,750 sf), a new maintenance building (8,800 sf), and a new covered storage building (7,375 sf).

The single story office building utilizes conventional steel column and beam framing with metal stud framing and trusses. Its facade will be modular face brick with a standing seam metal roof. It will be protected throughout with an automatic sprinkler system. The warehouse addition, new maintenance building, and new covered storage building will be a pre-engineered metal building structure with metal wall panels and standing seam metal roof. The warehouse addition and the existing vehicle storage area of the existing operations building will be protected with an automatic sprinkler system. The existing office portion of the operations building will not be protected with a sprinkler system and will be partitioned from the vehicle area with a fire barrier.

- B. Project Location: 685 Water Tower Bypass Campbellsville, KY 42718
 - 1. Owner: Taylor County RECC: 625 West Main Street Campbellsville, KY 42718
- C. Architect Identification: The Contract Documents, dated xx/xx/2026 were prepared for TCRECC by Mitchell and Hugeback Architects, Inc. (d.b.a. M+H Architects), 12747 Olive Blvd, Suite 150, St. Louis, Missouri, 63141, and the consultants named on the title sheet.
- D. Contractor: Cooperative Building Solutions (12755 Olive Blvd, Suite 200, St. Louis, MO 63141) is Construction Manager for this Project and is Project's Constructor. In Divisions 1 through 32 Specifications, the terms "Construction Manager" and "Contractor" are synonymous.

1.3 CONTRACTS

- A. Project will be constructed under a general construction contract that is comprised of multiple subcontracts as dictated by the bid packages as determined by the Construction Manager.

1.4 WORK SEQUENCE

- A. The Work shall be conducted in the sequence based on the schedule determined by the Construction Manager.

1.5 USE OF PREMISES

- A. General: Contractor shall have use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work, owner activity occurring on site, or to retain other contractors on portions of Project.

1.6 WORK UNDER OTHER CONTRACTS

- A. Separate Contract(s): The Owner has the right to award separate contracts for the performance of certain operations at the project site during the duration of the project.

1.7 CONTRACTOR SUPPLIED WORK IN CONJUNCTION WITH OWNER SUPPLIED WORK

- A. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.8 PRODUCTS ORDERED IN ADVANCE

- A. General: Owner has negotiated Purchase Orders with suppliers of material and equipment to be incorporated into the Work. Owner has assigned these Purchase Orders to Contractor. Costs for receiving, handling, storage if required, and installation of material and equipment are included in the Contract Sum.
 - 1. Contractor's responsibilities are the same as if Contractor had negotiated Purchase Orders, including responsibility to renegotiate purchase and to execute final Purchase-Order agreements.

1.9 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish portions of the work when described in the Construction Documents. The Work includes providing support systems to receive Owner's equipment and plumbing, mechanical, and electrical connections.
 - 1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
 - 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
 - 3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
 - 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
 - 5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
 - 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.

7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Construction Manager noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 32-division format and CSI/CSC's "MasterFormat" numbering system.
 1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.11 MISCELLANEOUS PROVISIONS

- A. The Contractor shall secure and pay for all permits, licenses and fees necessary and required for the prosecution of the project, including performance guarantees such as escrows or letters of credit required by utilities or other authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

SUMMARY

25012.00 / TCRECC

3.1 SCHEDULE OF PRODUCTS ORDERED IN ADVANCE

- A. Provided by Construction Manager.

END OF SECTION 011000

SECTION 012100 - ALLOWANCES**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 includes administrative and procedural requirements governing allowances.
 - 1. Certain materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
- C. Related Sections include the following:
 - 1. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3 SELECTION AND PURCHASE

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

1.4 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 show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.5 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 EXAMINATION**

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance amounts, when relevant, are indicated in individual specification sections or in the Bid Package documentation.

END OF SECTION 012100

SECTION 013300 - SUBMITTAL PROCEDURES**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 includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.
- B. Related Sections include the following:
 - 1. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mockups.
 - 2. Division 1 Section "Closeout Procedures" for submitting warranties Project Record Documents and operation and maintenance manuals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's and Construction Manager's responsive action.
 - 1. Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
 - 2. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
 - 3. Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
 - 4. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals.
 - 5. The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for

installation or performance of equipment or systems, all of which remain the responsibility of the Contractor. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations for supervision and construction procedures, and warranties. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

- B. Informational Submittals: Written information that does not require Architect's and Construction Manager's approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies Contract Drawings/Details will not be provided by Architect for Contractor's use in preparing submittals. CAD Floor plans for use as backgrounds may be provided if requested.
- B. Responsibility: It is the sole responsibility of the Contractor to coordinate, process and transmit all required submittals.
 - 1. The architect will keep a record of the submittals that are actually submitted, but it is the contractor's obligation alone to submit the information.
 - 2. The contractor's failure to make timely or any submittal at all, including any damages that may flow from the failure to make the appropriate submittals, is a failure of the contractor, and not the architect.
 - 3. The architect is not authorized nor required to insist on submittals being made, but may notify the contractor that they are required and then it is the contractor's obligation to comply.
 - 4. The architect's certification of pay applications is not certification or verification that all appropriate submittals have been made.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.

1. Initial Review: Allow ten (10) business days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow fifteen (15) business days for initial review of each submittal.
 - a. Structural submittals.
 3. Mechanical, Electrical, Plumbing and Fire Protection submittals. Direct Transmittal to Consultant: Not allowed. All submittals shall be provided to the Construction Manager before distribution to the design team.
 4. If intermediate submittal is necessary, process it in same manner as initial submittal.
 5. Allow ten (10) business days for processing each resubmittal.
 6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- F. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide adequate space on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect and Construction Manager.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Unique identifier, including revision number.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Other necessary identification.
- G. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect and Construction Manager will discard submittals received from sources other than Contractor.
1. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

- J. Use for Construction: Use only final submittals with mark indicating action taken by Architect and Construction Manager in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections. A single, complete submittal for all materials specified in each section is required. Architect may hold or return incomplete submittals without review until all required information is provided.
 - 1. Number of Copies: Submit one (1) copy of each submittal, in either paper or electronic (.pdf only) format, unless otherwise indicated. Architect, through Construction Manager, will return one (1) electronic copy. Contractor shall print, distribute and retain one returned copy as a Project Record Document.
 - 2. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:
 - a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Submit drawings and product data in either paper or electronic (.pdf only) format. Submit physical specimens of material and color samples. Architect, through Construction Manager, will return submittal with options selected.
 - b. Final Submittal: Submit one (1) copy, unless copies are required for operation and maintenance manuals. Architect, through Construction Manager, will return one (1) electronic copy. Contractor shall print and distribute as required. Retain one returned copy as a Project Record Document.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operating and maintenance manuals.
 - k. Compliance with recognized trade association standards.
 - l. Compliance with recognized testing agency standards.
 - m. Application of testing agency labels and seals.

- n. Notation of coordination requirements.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
- D. Samples: Prepare physical units of materials or products, including the following:
- 1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.
 - 2. Samples for Initial Selection: When a color is not shown on the drawings or in the specifications, submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - 3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - 4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 - 5. 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 final submittal and actual component as delivered and installed.

- a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of the variations.
 - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
6. Number of Samples for Verification: Submit two (2) sets of Samples. Architect will retain one (1) Sample set; remainder will be returned.
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
7. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- E. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product.
 2. Number and name of room or space.
 3. Location within room or space.
- F. Delegated-Design Submittal: Comply with requirements in Division 1 Section "Quality Requirements."

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 1. Number of Copies: Submit one (1) electronic (.pdf format) file of each submittal, unless otherwise indicated. Architect and Construction Manager will not return copies.
 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 3. Test and Inspection Reports: Comply with requirements in Division 1 Sections, General Conditions, and Supplementary General Conditions.
- B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- I. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
- J. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- K. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- L. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- M. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.

- N. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures"
- O. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- Q. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- R. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date

of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action. Architect may hold or return incomplete submittals without review until all required information is provided.
 - 1. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- C. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS**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 includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 1 Section "Allowances" for testing and inspecting allowances.
 - 2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 3. Divisions 2 through 32 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination,

testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.

- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 SUBMITTALS

- A. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

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

- C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
- H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect and Construction Manager fifteen (15) days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's and Construction Manager's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
1. Where services are indicated as Owner's responsibility, Contractor shall be responsible for scheduling and notifying testing agency to perform the quality-control services.
 - a. Contractor shall be responsible for payment of "stand-by time" charged by testing agencies which are the result of insufficient scheduling or notification.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

1. Testing agency will notify Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
 3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and reinspect corrected work.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field-curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within thirty (30) days of date established for the Notice to Proceed.
 1. Distribution: Distribute schedule to Owner, Architect, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 ACCEPTABLE TESTING AGENCIES**

- A. Provide names and qualifications of proposed testing agencies for review and approval of Owner, Architect and Construction Manager.

3.2 REPAIR AND PROTECTION

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

END OF SECTION 014000

SECTION 016000 - PRODUCT REQUIREMENTS**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 includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 1 Section "Allowances" for products selected under an allowance.
 - 2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
 - 3. Divisions 2 through 32 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

- D. **Manufacturer's Warranty:** Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. **Special Warranty:** Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- F. **Voluntary Alternate:** A product or system, other than those specified, that the contractor chooses to submit as an alternative capable of producing a cost benefit to the Owner. The voluntary alternate is submitted by the contractor at the time of bidding, as a separate cost with side-by-side comparative data to the specified product or system for which it is proposed to replace and any other supporting data required for analysis by the design team and Owner, and is not to be included in the base bid amount. The voluntary alternate is not reviewed or deemed equivalent to the specified products or systems at the time of the submission. Voluntary Alternates will be evaluated after bidding, prior to contract award if deemed beneficial to evaluate.

1.4 SUBMITTALS

- A. **Product List:** Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 - 3. **Initial Submittal:** Within 30 days after date of commencement of the Work, submit one (1) electronic copy of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 - 4. **Completed List:** Within 60 days after date of commencement of the Work, submit one (1) electronic copy of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.

5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
- B. Voluntary Alternates: Substitution requests will not be evaluated prior to Bid Date. To allow material suppliers and manufacturers to bid non-specified materials as "Voluntary Alternates", follow this procedure.
- a. The Base Bid and any Alternate Bids identified on the Bid Form shall include only specified materials or other formally approved substitutions.
 - b. When submitting bids, clearly identify non-specified materials as "voluntary alternates". Failure to do so will result in rejection of those materials during construction.
 - c. Include all applicable documentation required for substitution requests as identified below.
 - d. Submit "Voluntary Alternates" which result in a DEDUCT from the base bid amount on a separate sheet attached to the Bid Form.
 - e. Architect and Owner will consider and evaluate voluntary alternates that offer a cost savings for acceptance after receipt of bids.
- C. Substitution Requests: Submit one (1) electronic copy of each Voluntary Alternate request for further consideration upon request of Architect after bids are received [at least seven (7) business days before bids are due]. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Provide a side-by-side comparison including all the material and testing data references.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall

- Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
- j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation. Construction Manager will notify Bidder(s) of acceptance or rejection of proposed voluntary alternate.
- a. Form of Acceptance: Inclusion in Contract for Construction.
- D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
- 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 9. Protect stored products from damage.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
 3. Refer to Divisions 2 through 32 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:

1. **Product:** Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered, unless otherwise indicated.
2. **Manufacturer/Source:** Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
3. **Products:** Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
4. **Manufacturers:** Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
5. **Available Products:** Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. **Available Manufacturers:** Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. **Product Options:** Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. **Basis-of-Design Products:** Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product[s]" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Substitutions may be considered, unless otherwise indicated.
9. **Visual Matching Specification:** Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches

Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

- a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
11. 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.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received no less than 7 days before the receipt of bids. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION**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 includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 1 Section "Submittal Procedures" for submitting surveys.
 - 2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

- A. Qualification Data: For land surveyor and/or professional engineer 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. Certificates: Submit certificate signed by land surveyor and/or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit two copies signed by land surveyor and/or professional engineer.
- E. Final Property Survey: Submit two copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and/or Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: 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 Construction Manager not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests as "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor and/or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor and/or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

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

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable

timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING**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 includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.
 - 2. Divisions 2 through 32 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Construction Manager's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 1. Primary operational systems and equipment.
 2. Fire-protection systems; including fire rated partitions/barriers.
 3. Control systems.
 4. Communication systems.
 5. Conveying systems.
 6. Electrical wiring systems.
 7. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain-wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 - a. Concrete finishes.
 - b. Preformed metal panels.
 - c. Roofing.
 - d. Firestopping.
 - e. Window wall system.
 - f. HVAC enclosures, cabinets, or covers.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

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 Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers 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, and subsequently patch as required to restore surfaces to their original condition.

- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete & Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 017329

SECTION 017700 - CLOSEOUT PROCEDURES**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 includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project Record Documents.
 - 3. Operation and maintenance manuals.
 - 4. Warranties.
 - 5. Instruction of Owner's personnel.
 - 6. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
 - 2. Divisions 2 through 32 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit one (1) electronic copy of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.6 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.
- B. Record Drawings: Maintain and submit one (scanned) electronic set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Record Specifications: Submit one (1) electronic copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

1.7 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping diagrams.
 2. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of Installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.
1. If acceptable by Owner, provide a digital binder, organized on an external USB flash drive in lieu of physical binder.

1.8 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

- B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner with at least seven (7) days' advance notice.
 - 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
 - 1. System design and operational philosophy.
 - 2. Review of documentation.

3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

- m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 024116 - BUILDING DEMOLITION**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the demolition and removal from site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of buildings and site improvements or parts of buildings and site improvements.
 - 2. Abandoning in place or removing below-grade construction as indicated on drawings.
 - 3. Disconnecting, capping or sealing, and abandoning in-place or removing site utilities as indicated.
 - 4. Salvaging items for reuse by GC.

1.4 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- C. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to GC ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.5 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 SUBMITTALS

- A. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping or re-routing of utility services.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.8 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings or parts of buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied areas will not be disrupted.
 - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings and areas.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged.
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

3.2 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 - 1. Arrange to shut off indicated utilities with utility companies or Owner.
 - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- C. Existing Utilities: Refer to Division 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- E. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until ready to re-install.
 - 4. Transport items to storage area designated by GC.
 - 5. Protect items from damage during transport and storage.

3.3 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction, and as indicated.
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

- A. General: Demolish existing buildings and site improvements as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 - 2. Maintain fire watch during and for at least 12 hours after flame cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide

- alternates routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.5 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be salvaged are indicated on Drawings.
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
 - 1. Remove below-grade construction, including foundation walls, and footings, completely.
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside footprint indicated for new construction. Abandon utilities outside this area.
 - 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 2 Section "Earthwork."

3.6 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 2 Section "Earthwork."
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and legally dispose of them.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

SECTION 024119 - SELECTIVE DEMOLITION**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the demolition and removal from site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Repair procedures for selective demolition operations.
- B. Related Sections include the following:
 - 1. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
 - 2. Division 2 Section "Building Demolition" for demolition of entire buildings, structures, and site improvements.
 - 3. Division 23 Sections for demolishing, cutting, patching, or relocating mechanical items.
 - 4. Division 26 Sections for demolishing, cutting, patching, or relocating electrical items.

1.4 DEFINITIONS

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

1.5 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.6 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Locations of temporary partitions and means of egress.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Professional Engineer Qualifications: Comply with Division 1 Section "Quality Requirements."

- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.8 PROJECT CONDITIONS.

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract. Retain below and delete above if asbestos abatement is part of Work of this Contract. Consult a professional liability insurance carrier for current recommendations. Indemnification and a waiver of claims may be required from Owner as a condition for providing services related to asbestos abatement.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

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

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- D. Utility Requirements: Refer to Division 21 and 28 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- C. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
- D. Protect existing site improvements, appurtenances, and landscaping to remain.
- E. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- F. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 3. Cover and protect furniture, furnishings, and equipment that have not been removed.
- G. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

- H. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

3.4 POLLUTION CONTROLS

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

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 9. Dispose of demolished items and materials promptly.
 - 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

- B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Reinstalled Items: Comply with the following:
 - 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- F. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- G. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- H. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.
- I. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

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

END OF SECTION 024119

SECTION 024213 – RECLAMATION OF VINYL COMPOSITION TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Reclamation Plan for vinyl composition tile.
- B. Related Sections:
 - 1. Section 017419 – Construction Waste Management and Disposal.
 - 2. Section 024119 - Selective Demolition.

1.3 DEFINITIONS

- A. Armstrong: Armstrong World Industries, Inc.
- B. Recycler/Consolidator/C&D Processor: The entity providing reclaimed vinyl composition tile, contained in palletized Gaylord boxes, to Armstrong.
- C. Contractor: Entity removing vinyl composition tile for reclamation.
- D. Common Carrier: Independent carrier utilized by Armstrong for delivering full trailers of reclaimed vinyl composition tile to Armstrong.

1.4 SUBMITTALS

- A. Incorporate flooring into the project site Waste Management Plan as a material to be recycled.

1.5 QUALITY ASSURANCE

- A. Materials Acceptable for Recycling:
 - 1. All brands of 12 x12 vinyl composition tiles that do not fall into any of the categories set forth in subsection B below
- B. Materials Not Acceptable for Recycling:
 - 1. Asbestos containing flooring tiles.

2. Flooring tiles installed with adhesives containing asbestos.
 3. Flooring tiles being removed from a location undergoing any type of asbestos or hazardous abatement.
 4. Wet, moldy or weathered flooring tiles.
 5. Flooring tiles or gaylord boxes/pallets which contain debris (garbage, construction waste).
 6. Flooring tiles not packaged according to packaging procedures set forth below.
 7. Flooring tiles or roll-off bins or containers, used by Demolition and Construction Specialists, which contain debris (garbage, construction waste).
 8. Vinyl composition tiles containing aluminum oxide grit as present in slip retardant tiles.
 9. Flooring tile being reclaimed that may have come into contact with asbestos containing material, hazardous waste materials or special waste.
- C. For approval to recycle flooring tiles, contact the Armstrong Recycling Center at 877-276-7876, select option 2, then option 7 to be the process. You will need to submit information where the flooring tiles are located, including an asbestos report to verify the flooring tiles meet our requirements and for assistance to facilitate recycling.
- D. Armstrong may reject flooring tiles, if terms and conditions, set forth in this Reclamation Guide Specification, are not met.

1.6 PROJECT AND MATERIAL APPROVAL

- A. Register Your Recycle Project: Contact the Armstrong Flooring Recycling Center at 877-276-7876 option 2, 7.
- B. Required Information to approve your project for recycling:
1. Contact information for the recycle project.
 2. Building information (Year of Building Construction, GC or Demo Contractor, Building use, copy of an asbestos survey, details on any prior or current abatement where flooring is removed or if there is a presence of any other potential hazards, for example: lead paint remediation).
 3. Flooring Information – Manufacturer, date of install, type of adhesive used for install, were any “cure in place urethanes” used, quantity, color(s), timing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULING, PACKAGING AND SHIPPING PROCEDURES

- A. Upon approval of the flooring material for recycling by the Armstrong Recycling Center, Armstrong will send gaylord boxes, pallets and return authorization labels to the project site where the Approved Flooring Material is located.

Contractor is responsible for removing flooring tiles to be recycled.

- B. Full Truckload Procedure:

1. Armstrong to supply gaylord boxes and pallets to project site based upon estimated return quantity. All gaylord boxes sent must be returned to Armstrong. Gaylord boxes lost onsite will be the responsibility, to include the cost of replacement, of the Recycler. Armstrong will not accept other's gaylord boxes and pallets.
 2. Approved flooring materials will be contained, in a manner, allowing both secure shipment by trailer and the ability of Armstrong employees to safely inspect and unload the trailers' contents. For this reason, all approved flooring materials sent to Armstrong must be returned as follows:
 - a. L: 45 1/8" X W: 37 1/8" X D: 39 1/2" inside dimension (5) walled gaylord box stacked on 40"x48" pallet. Gaylord box capacity 1,800 lbs. and should not exceed 3/4 full. Gaylord top must be shrink-wrapped.
 - b. Colors must be separated into different gaylord boxes when diverse.
 3. Gaylord boxes and pallets must be kept dry. Wet material is not acceptable and will be returned. Gaylord boxes must be labeled with return authorization labels per Armstrong requirements.
 4. Pallets must be secured within trailers to prevent shifting in transit. Carriers will provide load stabilizers.
 5. Armstrong will pay for the return freight of full trailers of approved material, all of which are defined as a minimum of 31,200 square feet as follows:
 - a. Twenty-four L: 45 1/8" x W: 37 1/8"x D: 39 1/2" gaylord boxes palletized (40"x48"pallets). Proper loading equipment must be available at the job site. This is the responsibility of the recycler.
 6. It is the recycler's responsibility to ensure that only full trailer loads of approved flooring materials are shipped.
- C. Less Than Full Truckload Procedure:
1. Where the amount of approved flooring materials from a site is insufficient for a full trailer load, a local recycler/consolidator may elect to consolidate approved flooring materials in a secure and dry location, until a full trailer load is ready for shipment. The recycler/consolidator will ensure that all such aggregate shipments are and remain clearly labeled as to their origin and date of approval by an Armstrong employee. Coordinate with recycler/consolidator on best reclaiming options depending on job site loading conditions and equipment available.
 - a. Recycler/consolidator/C&D Processor will assist in supplying gaylord boxes and pallets supplied by Armstrong. If recycler/consolidator elects to use roll-offs bins or containers onsite:
 - 1) Material must be clean and dry
 - 2) Roll-off bins or containers must be free of standing water or other contamination prior to the loading of approved flooring material.
 - 3) No wood, metal, construction debris, trash or hazardous materials of any kind can be included.
 - 4) Material should be placed in a roll-off container. This container must have a water impermeable cover such that material inside does not get wet. Material should not be loaded above the top of the container
 - 5) Container should have visible Armstrong RA label attached.
 - 6) Removed tiles, prior to shipment, must be transferred from roll-off bins or containers to approved gaylords supplied by Armstrong, set forth above, for shipment to the designated Armstrong Plant. Handling will then comply with full truckload procedure.
 2. When local consolidation is not available a LTL pick up may be arranged in some areas for six (6) gaylords (8,000 sq. ft.) or more of approved flooring materials. Armstrong will

- pay the return freight of these LTL pickups. LTL pickup must be pre-approved by Armstrong when other options are not available.
3. The recycler/consolidator/C&D Processor retains ownership of approved flooring materials until it is received and accepted at the destination, the Armstrong Plant, as defined by the terms of shipment, F.O.B. (Free on board) destination, despite Armstrong's payment of the freight costs for full trailer loads. While the Armstrong approved common carrier is not a party to this agreement, the following describes their responsibilities. The common carrier that Armstrong has selected is responsible for the transport of the approved flooring materials from the pickup location to Armstrong's plant. This carrier is an independent contractor utilized by Armstrong and required to demonstrate general liability insurance coverage that meets or exceeds industry standards.

END OF SECTION 024213

SECTION 042000 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Decorative concrete masonry units.
 - 3. Face brick.
 - 4. Masonry ties, anchors, flashings and other accessories.
- B. See Division 5 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
- C. See Division 7 Section "Sheet Metal Flashing and Trim" for sheet metal flashings and trims and furnishing manufactured reglets installed in masonry joints for metal flashing.
- D. See Division 7 Section "Spray Polyurethane Foam Insulation" for continuous wall cavity insulation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. For reinforcing steel; Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 - 2. For ties, anchors, flashings and accessories; Product data indicating material type, composition, thickness, and installation procedures.

- C. Samples for each type and color of exposed masonry units and colored mortars, including special shapes when required.
- D. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.
 - 1. For masonry units include material test reports substantiating compliance with requirements.
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1.5 QUALITY ASSURANCE

- A. Preconstruction Testing Service: Owner may engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.
 - 1. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
 - 2. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
 - 3. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
- B. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- C. Provide flashing materials by single manufacturer with not less than twenty five years of experience in manufacturing flexible flashing products. Flashing materials must be able to withstand 400° F temperature without changing the long term performance of the flashing.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. The following procedures should also be followed:
 - 1. The project superintendent should keep in close touch with weather bureau on critical days.
 - 2. A windbreak shall be installed around all mix material.
 - 3. All material mix shall be maintained at a temperature between 60 degrees F and 70 degrees F when mixing mortar.
 - 4. Warm water shall be used in mixing.
 - 5. Temperature must be at least 27 degrees F and rising before starting to lay block.
 - 6. At least five (5) hours should be allowed for setting before the temperature drops to 25 degrees F.
 - 7. No brick shall be laid after the temperature drops below 27 degrees F.

- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- C. Cover tops of walls completely after each day's work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 COLORS, TEXTURES, AND PATTERNS

- A. Exposed Masonry Units: As indicated by manufacturer's designations or as selected from manufacturer's full range.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 1. Provide bullnose units for exposed outside corners, door jambs and window jambs/sills, unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength for exterior units and where indicated at the Office HQ.
 - 1. Products: Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
- C. Concrete Masonry Units: ASTM C 90
 - 1. Concrete Masonry Units (CMUs) shall conform to the requirements of ASTM C90-12 (or later edition), "Specification for Load-Bearing Concrete Masonry Units", with the exceptions noted below. Lightweight aggregates used in the manufacture of Concrete Masonry Units shall be Expanded Shale Clay or Slate aggregates conforming to the requirements of ASTM C331, "Specification for Lightweight Aggregates for Concrete Masonry Units". Natural aggregates shall conform to ASTM C 33 "Specification for Aggregates for Concrete".
 - a. Exceptions to ASTM C90:
 - 1) The oven-dry density of the CMU, when tested in accordance with ASTM C140, shall not exceed 93 lb/cu ft.

- 2) The minimum compressive strength (average of 3 units) requirement shall be 2,500 psi at the time of delivery. The provisions of Section 5.1.1 of ASTM C90 shall apply for evaluating compressive strength test results.
- b. The producer of the concrete masonry units shall supply a current "SmartWall" certification from the Expanded Shale Clay and Slate Institute member supplying the lightweight aggregates.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
3. Weight Classification: Normal weight.
4. Pattern and Texture for Decorative Units @ hardened enclosure:
 - a. Standard pattern, ground finish.
 - b. Standard pattern, split-face finish.
5. Color:
 - a. As selected from manufacturer's full range.
 - b. Integral color where exposed to view at exterior building applications.
 - c. Standard color where in concealed construction or interior.

2.4 MASONRY LINTELS

- A. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

2.5 BRICK

- A. General: Provide shapes indicated and as follows:
 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216 or C 652, Grade SW, Type FBS or HBS.
 1. Face Brick "A" as indicated on drawings (Field Brick): "Indian Full Range Coarse Velour" as manufactured by Belden Brick Company.
 2. Face Brick "B" as indicated on drawings (Accent Brick): "8531 Velour" as manufactured by Belden Brick Company.
 3. Specified brick is available locally from Earthworks Stone, Chesterfield, MO, (800) 887-4555.
 4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 5. Modular Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long. Use special shapes where detailed.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Pigments: Iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Products:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.
- D. Colored Cement Product: Packaged blend made from portland cement and lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 2. Products:
 - a. Colored Portland Cement-Lime Mix:
 - 1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 2) Lafarge North America Inc.; Eaglebond.
 - 3) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
- E. Aggregate for Mortar: ASTM C 144.
 - 1. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C 404.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated. Use only with pre-approval of Structural Engineer and Architect.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
 - 1. Products:
 - a. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- I. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 641; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.

1. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
2. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
3. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
6. Multiwythe Masonry:
 - a. Adjustable (two-piece) type, with one side rod at each face shell of backing wythe and with ties that extend into facing wythe. Ties engage eyes or slots in reinforcement and extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face. Ties have hooks or clips to engage a continuous wire in the facing wythe.

2.8 TIES AND ANCHORS

A. Materials:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 3/16-inch diameter, hot-dip galvanized steel wire.

D. Partition Top anchors: 0.097-inch thick metal plate with 3/8-inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

F. Adjustable Masonry-Veneer Anchors

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2.9 EMBEDDED FLASHING MATERIALS

Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 7 Section "Sheet Metal Flashing and Trim."

1. Metal Flashing Terminations: Extend at least 1 1/2 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.
 2. Metal Drip Edges: Extend at least 1 1/2 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed. Trim or file outside corners at sidewalks and doorways to remove sharp edges. Product to be Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2D (dull, cold rolled) finish, 25 ga. minimum.
- B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:
1. Stainless steel core flexible flashing with drainage fabric:
 - a. Type: Engineered system, with high resistant to damage, composite with a stainless steel with non-asphalt adhesive polymer fabric laminated to one stainless steel and non-woven drainage fabric laminated to opposing face with non-asphalt adhesive.
 - b. Stainless steel type: ASTM A240.
 - c. Fabrics:
 - a. Polymer fabric; laminated back face of stainless steel core.
 - b. Non-woven drainage fabric: Fabric laminated to front face stainless steel core.
 - d. Size: Manufacturer's standard width rolls.
 - e. Basis of Design Product: York Manufacturing, Inc.; Flash-Vent SS or approved equivalent.
 - c. Tensile strength; 100,000 psi minimum average
 - d. Puncture Resistance; 2,500 pounds average
 - e. When tested as manufactured, product resists growth of mold pursuant to test method ASTM D3273.
 - f. Fire Rating; flame spread and smoke generation - rated Class A, ASTM E84
 - g. Certify the use of domestic manufactured stainless steel for flashing.
 - f. Accessories:
 - a. Mastic/sealant: Product standard of quality is York Manufacturing, Inc.; Uni-verSeal US100. One part 100% solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50.
 - b. Outside corner and inside corner material; manufacturer's standard available units using 26 gauge stainless steel.
 - c. End dam: Product may be folded in line with the flashing material or utilize preformed end dams by manufacturer using 26 gauge stainless steel.
 - d. Splice material: Product standard of quality is York304 SS by York. Manufacturer's standard self-adhered metal material; material matching system material or use Multi-Flash Stainless Steel 6" lap piece and polyether sealant

- as a splice.
 - e. Termination bar: Product standard of quality is York T-96 termination bar. Manufacturer's standard 1" composite material bar or a 1" 26 gauge stainless steel termination bar with sealant lip.
 - f. Repair and other materials/accessories: Manufacturer's standard.
 - g. Fasteners: Domestic manufactured fastener types and sizes recommended by flashing manufacturer for intended use.
 - C. Through-Wall Flashing Pan for single wythe masonry:
 - a. Products:
 - 1) BlockFlash by Mortar Net Solutions, or approved equal. Provide all necessary accessory materials and install in accordance with Manufacturer's recommendations.
 - D. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."
 - E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following, unless otherwise indicated:
 - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Products:
 - 1) Advanced Building Products Inc.; Mortar Maze weep vent.
 - 2) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - 3) Hohmann & Barnard, Inc.; Quadro-Vent.
 - 4) Wire-Bond; Cell Vent.
 - b. Use only at base of wall and above continuous shelf angles.
- E. Cavity Drainage Material: Free-draining mesh with insect barrier, made from polymer strands that will not degrade within the wall cavity.
 - 1. Provide one of the following configurations:

- a. Strips, full-depth of cavity and 12 inches wide, with dovetail shaped notches 7 inches deep.
2. Products:
 - a. Mortar Net Solutions; Mortar Net.
 - b. York Manufacturing; Weep Armor

2.11 INSULATION

- A. Cavity Wall Insulation
 1. Spray Polyurethane Foam Insulation: see Section 072130.

2.12 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.13 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures without consent of structural engineer, unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
 1. For masonry below grade or in contact with earth, use Type S.
 2. For reinforced masonry, use Type S.
 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 1. Pigments shall not exceed 10 percent of portland cement by weight.

- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Do not install units with chipped edges, cracks, breaks or other surface imperfections.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- E. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, or 1/2 inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, or 1/2 inch maximum.

3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

- E. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

- A. Lay concrete masonry units as follows:
 - 1. With bed and head joints of face shells fully bedded in mortar.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay brick masonry units with completely filled bed and head joints; butter all four edges of ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.4 MASONRY JOINT REINFORCEMENT

- A. General: Install in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.5 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached and seismic anchors through sheathing to wall framing and/or to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners.
 - 2. Embed tie sections or connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and **24 inches** o.c. horizontally with not less than 1 anchor for each **2.67 sq. ft.** of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches around perimeter.

3.6 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
 1. Prohibited practice: Bonding or splicing to non-woven drainage fabric.
- B. Install flashing as follows, unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.
 2. Extend flashing 6" minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use pre-manufactured units made of 26 gauge stainless steel.
 3. Flashing width: Width required starting 1.5" to the exterior of the outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2". After inspection by the agreed upon parties the flashing should be cut flush with the leading edge of the brick.
 4. Splice end joints by butting ends together over 4" wide piece of self-adhering stainless steel flashing. The self-adhering stainless steel flashing should be sealed metal face down on to the substrate with the mastic. Remove the release linear and butt the two piece of flashing together and embed them into the splice sealant. Then seal the butt seam with sealant.
 5. Masonry back-up:
 - a. Surface mount flashing after damp proofing installation specified in Damp Proofing Section in accord with manufacturer's installation instructions.
 - b. Apply flashing with drainage surface to outside.
 - c. Fasten to masonry back-up surface at top by embedding in layer of sealant and use a termination bar to fasten to the backer wall and seal the top of the termination bar with sealant.
 6. Stud back-up with sheathing:

- a. Surface mount flashing after certified compatible damp proofing installation specified in Damp Proofing Section in accord with manufacturer's installation instructions
 - b. Apply flashing with drainage surface to the outside.
 - c. Fasten to stud back-up surface at top by embedding in layer of sealant and use a termination bar to fasten to the backer wall and seal the top of the termination bar with sealant.
7. Confirm compatibility with manufacturer's mutual letters for all lapping components, Air barrier installation lapping over flashing top in the Air Barrier Section.
 8. Lay flashing in continuous bead of sealant on masonry supporting steel.
 9. Fold ends of flashing at end of opening to form dam; seal with polyether sealant or use purchased manufacturers preformed end dams.
 10. Inside and outside corners: Purchase manufactured corners from manufacturer.
 11. Do not coat the entire drainage fabric with air barrier. Leave the drainage fabric exposed at least an inch over the top of the mortar droppings.
 12. Weep vent protection use the geotextile drainage and install it on the third row height of standard bricks to have the fabric reach the base of the flashing and covering the weep vents.
 13. Cover flashing immediately after installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Space weep holes 24 inches o.c., unless otherwise indicated.
- D. Place cavity drainage material in cavities with insect barrier against the veneer cavity side open vents or weep holes to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.7 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.8 FIELD QUALITY CONTROL

- A. Inspectors: Owner may engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
 - 1. Payment for these services will be made by Owner.
 - 2. Contractor shall provide sufficient notice for Owner to coordinate testing agency work.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.9 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
1. Care shall be taken during the progress of the work to keep facework as clean as possible. All droppings, etc., on sills and ledges shall be removed before hardening.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 2. Protect adjacent surfaces from contact with cleaner.
 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 4. Do not use high pressure water cleaning.
 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 8. After cleaning, any imperfect joints shall be refilled and pointed. All work must be left clean and perfect at completion of building.

3.10 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed, if acceptable to Geotechnical Engineer.
1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
 2. Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 055100 - METAL STAIRS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Preassembled steel stairs with concrete-filled treads.
 - 2. Industrial-type stairs with steel grating treads.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 1 Section "Quality Requirements," to design stairs and railings.
- A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 - 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.
- B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.

- C. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.

- 1. Component Importance Factor: 1.5.

1.5 SUBMITTALS

- A. Product Data: For metal stairs.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Professional engineer qualifications are specified in Division 1 Section "Quality Requirements."
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 COORDINATION

- A. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified, unless noted otherwise.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

- E. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- F. Iron Castings: Either gray iron, ASTM A 48/A 48M, Class 30, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170).

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Shop Primers: Provide primers that comply with Division 9 Section "Painting," and Section "High-Performance Coatings."
- C. Concrete Materials and Properties: 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 (20 MPa), unless otherwise indicated.

2.4 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish exposed welds smooth and blended.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - 4. Form bent-metal corners to smallest radius possible without impairing work.
 - 5. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- B. Stair Framing: Fabricate stringers of steel channels. Construct platforms of steel channel headers and miscellaneous framing members.
 - 1. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch (1.7 mm).
- D. Metal Floor Plate Stairs: Form treads and platforms from rolled-steel floor plate of thickness needed to comply with performance requirements but not less than 1/4 inch (6.4 mm). Form treads

with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and weld treads to brackets.

1. Fabricate treads and platforms from steel grating with 1 1/2-inch-by-3/16-inch (25-by-5-mm) bearing bars at 1/2 inch (17 mm) o.c. maximum and crossbars at 4 inches (100 mm) o.c.
2. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal stairs after assembly.
- B. Hot-dip galvanize all exterior items and other items indicated to be galvanized. Comply with ASTM A 123/A 123M or ASTM A 153/A 153M as applicable.
 1. Plug all vent holes provided in exterior pipe and tube railings after galvanizing.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below for environmental exposure conditions of installed products:
 1. Exterior Stairs (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- B. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- D. Place and finish concrete fill for treads and platforms to comply with Division 3 Section "Cast-in-Place Concrete."
- E. Attach handrails to wall with wall brackets.
 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt
 2. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs.

F. Adjusting and Cleaning:

1. 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.
2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - Steel pipe railings.
- B. See Division 5 Section "Metal Stairs" for steel tube railings associated with metal stairs.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide railings capable of withstanding 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. Top Rails of Guards:
 - 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.
 - 3. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Uniform load of 25 lbf/sq. ft. applied horizontally.
 - c. Infill load and other loads need not be assumed to act concurrently.

- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. Product Data: For railings, grout, anchoring cement, and paint products.
 - 1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Samples: For each exposed finish required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Pipe and Tube Railings:
 - a. Pisor Industries, Inc.
 - b. Sharpe Products.
 - c. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.2 METALS

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
- B. Steel and Iron:
 - 1. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 2. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 3. Castings: Either gray or malleable iron, unless otherwise indicated.
 - a. Gray Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
 - b. Malleable Iron: ASTM A 47/A 47M.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide concealed fasteners, unless unavoidable or standard for railings indicated.
 - 1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

- B. Anchors: Provide cast-in-place or torque-controlled expansion anchors, 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, as determined by testing per ASTM E 488.
- C. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- D. Shop Primers: Provide primers that comply with Division 9 painting Sections.
- E. Grout and Anchoring Cement: Factory-packaged, nonshrink, nonmetallic grout complying with ASTM C 1107; or water-resistant, nonshrink anchoring cement; recommended by manufacturer for exterior use.

2.4 FABRICATION

- A. General: Fabricate railings to comply with design, dimensions, and details indicated, but not less than that required to support structural loads.
- B. 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. Grind all welds smooth.
- C. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings.
- D. Form changes in direction by bending or by inserting prefabricated elbow fittings as required by detailing.
- E. Form curves by bending in jigs to produce uniform curvature; maintain cross section of member throughout bend without cracking or otherwise deforming exposed surfaces.
- F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

2.5 FINISHES

- A. Steel and Iron:
 - 1. Galvanized Railings: Hot-dip galvanize exterior railings, after fabrication, to comply with ASTM A 123/A 123M. Provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
 - a. Plug all vent holes provided in pipe and tube railings after galvanizing.
 - 2. Shop-Primed Steel Finish: Prepare to comply with **SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning"** and apply primer to comply with SSPC-PA 1.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. General: Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation.
 - 1. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 2. 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 in 12 feet.
- B. Anchor posts in concrete by inserting as detailed on drawings.
- C. Attach handrails to wall with wall brackets.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt
 - 2. For steel-framed partitions, fasten to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
 - 3. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.
- D. Adjusting and Cleaning:
 - 1. 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.
 - 2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Wood blocking, cants, and nailers.
 - 3. Wood furring and grounds.
 - 4. Plywood backing panels.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
 - 1. Include data for wood-preservative and fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.
- C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.
 - 4. Powder-actuated fasteners.
 - 5. Expansion anchors.
 - 6. Metal framing anchors.

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPAC20 (lumber) and AWPAC27 (plywood).
 1. Use Exterior type for exterior locations and where indicated.
 2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
 3. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat all rough carpentry, unless otherwise indicated. [items indicated on Drawings, and the following:]
 1. Concealed blocking.
 2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
 1. Mixed southern pine, No. 2 grade; SPIB.
 2. Eastern softwoods, No. 2 Common grade; NeLMA.
 3. Northern species, No. 2 Common grade; NLGA.
 4. Western woods, Construction or No. 2 Common grade; WCLIB or WWP.

2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.
- B. Power-Driven Fasteners: NES NER-272.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.7 METAL FRAMING ANCHORS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by the following:
 - 1. Simpson Strong-Tie Co., Inc.
- D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated or of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- E. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports, unless otherwise indicated.
- E. Comply with AWWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Fastening Schedule adopted by local building department, or in its absence use "Fastening Schedule," in latest edition of ICC's International Building Code.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - GYPSUM SHEATHING**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Glass-mat gypsum sheathing board that has been coated in a controlled environment with a synthetic vapor permeable air & water barrier membrane at Exterior Walls in Office Building.
- B. Related Sections include the following:
 - 1. Division 7 Section "Sheet Metal Flashing and Trim" for flashing installed with gypsum sheathing.
 - 2. Division 7 Section "Joint Sealants" for sealants applied with gypsum sheathing.
 - 3. Division 9 Section "Gypsum Board Assemblies" for steel framing and interior gypsum panels incorporated into assemblies with gypsum sheathing on the exterior.

1.4 DEFINITIONS

- A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockup of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Include junction with roofing, building corner condition, and foundation wall intersection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

1.8 COORDINATION

- A. Glass Mat Gypsum Sheathing Board:
 1. Do not leave exposed to weather for more than 180 days.

PART 2 - PRODUCTS

2.1 GYPSUM SHEATHING

- A. Glass Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.
 1. Basis-of-Design: Provide USG Corporation and Tremco Incorporated; Securock® ExoAir®430 Panel or approved equal.
 2. Type and Thickness: Type X, 5/8 inch thick.
 3. Air and Water Resistive Coating Thickness: Minimum 20 mils dry-film thickness (DFT).
 4. Size: 48 by 96 inches for vertical installation.
 5. Edges: Square.
 6. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
 7. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference when tested according to ASTM E2178.
 8. Vapor Permeance: Minimum Between 1.0 and 10 perms when tested according to ASTM E96/E96M, Water Method, Procedure B.
 9. Sheathing Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested according to ASTM E2357.

2.2 WEATHER-RESISTANT BARRIER

- A. Product is Factory applied. Follow manufacturer's guidelines on any field touch up requirements.

2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Glass-Mat Gypsum Sheathing Board: Provide joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated, and complying with requirements for elastomeric sealants specified in Division 7 Section "Joint Sealants."
 - 1. Silicone Emulsion Sealant: ASTM C 834, compatible with sheathing tape and sheathing, recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - a. Seal joints between sheathing board and adjacent materials, concrete curbs, wood blocking at sills, and all flashings.
 - 2. Glass-Fiber Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.4 ACCESSORY MATERIALS

- A. Fasteners: 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 B 117.
 - 1. For steel framing less than 0.0329 inch thick, attach sheathing with steel drill screws complying with ASTM C 1002.

PART 3 - EXECUTION

3.1 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and manufacturer's written instructions.
- B. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
 - 1. Install boards with a 3/8-inch setback where non-load-bearing construction abuts structural elements.
 - 2. Install boards with a 1/4-inch setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

- F. Vertical Installation: Install board vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

3.2 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written recommendations.
 - 1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.3 PROTECTION

- A. Provide temporary measures to protect building interiors from air infiltration and water penetration if glass-mat sheathing is exposed to weather for extended periods..

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Plastic-laminate cabinets.
 - 2. Plastic-laminate countertops.
 - 3. Solid-surfacing-material countertops.
 - 4. Shop finishing of woodwork.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For solid-surfacing material, cabinet hardware and accessories, handrail brackets and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
 - 1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
 - 2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.
 - 3. Plastic-laminates, for each type, color, pattern, and surface finish.
 - 4. Thermoset decorative panels, for each type, color, pattern, and surface finish.
 - 5. Solid-surfacing materials.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with AWT's "Architectural Woodwork Quality Standards." Premium Grade.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wood Products:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD
 - 3. Particleboard: ANSI A208.1, Grade M-2 [M-2-Exterior Glue]
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1
- B. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
- D. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Manufacturers: As shown on the drawings:

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.

F. Locks: BHMA A156.11, Door locks: E07121. Drawer locks: E07041.

- F. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated. See finish specifications for finish.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, fire-retardant-treated, kiln-dried to less than 15 percent moisture content.

2.4 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

1. Interior Woodwork Grade: Premium [Custom] [Economy].

2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.

- B. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Fire Rating: Indicated on door schedule on drawings.

- C. Plastic-Laminate Cabinets:

1. AWI Type of Cabinet Construction: Flush overlay
2. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:
 - a. Horizontal Surfaces Other Than Tops: Grade HGS.
 - b. Postformed Surfaces: Grade HGP.
 - c. Vertical Surfaces: Grade HGS.
 - d. Edges: Grade HGS- PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
3. Materials for Semiexposed Surfaces Other Than Drawer Bodies: Thermoset decorative panels Grade VGS
4. Drawer Sides and Backs: HPDLON 7-PLY veneer core.
5. Drawer Bottoms: Thermoset decorative panels.
6. Colors, Patterns, and Finishes: As indicated by manufacturer's designations or selected by Architect from manufacturer's full range.
7. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

- D. Plastic-Laminate Countertops:

1. High-Pressure Decorative Laminate Grade: HGS.
2. Colors, Patterns, and Finishes: As indicated by manufacturer's designations or selected by Architect from manufacturer's full range.
3. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Solid-Surfacing-Material Countertops:

1. Solid-Surfacing-Material Thickness: 3 cm.
2. Colors, Patterns, and Finishes: As indicated by manufacturer's designations or as selected from manufacturer's full range.
3. Fabricate tops in one piece with loose backsplashes for field application. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.5 SHOP FINISHING

- A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips, or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Caulk space between backsplash and wall, and joint between backsplash and countertop with sealant specified in Division 7 Section "Joint Sealants."

END OF SECTION 064023

SECTION 066700 – BULLET RESISTANT COMPOSITE PANELS**PART 1 - GENERAL****1.1 REFERENCE**

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment & ASTM E119-98-Standard Test Methods for Fire Tests of Building Construction and Materials, NIJ Standard 0108.01-(National Institute of Justice) Standard for Ballistic Resistant Protective Materials, MIL-P-46593A-Numerical simulation of ballistic impact on composite laminates, MIL-STD-622F-V50 Ballistic Test for Armor.

1.2 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

- A. This Section includes bullet resistant items for the District Office Building Lobby as follows:
 - 1. Bullet resistant Fiberglass panels
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealants applied with gypsum sheathing.
 - 2. Division 8 Section "Bullet Resistant Glazing"
 - 3. Division 9 Section "Gypsum Board Assemblies" for steel framing and interior gypsum panels incorporated into assemblies with gypsum sheathing on the exterior.

1.5 SUBMITTALS

- A. The following shall be submitted by the manufacturer in accordance with Sections 13070 and any Special Contract Requirements: Submit for approval prior to fabrication: samples, test reports, shop drawings (dimensioned profiles including anchorage and finishes), product specifications, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents. ASTM E119-98 One Hour Fire Rating of Building and Construction Materials. Manufacturer's Instructions for installation of TSS Bullet Resistant Fiberglass Panels. All required submittals shall be approved prior to installation.

1.6 DESIGN

- A. Through the design, manufacturing techniques and material application the Bullet Resistant Fiberglass shall be of the “non-ricochet” type. This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

1.7 QUALITY ASSURANCE

- A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of three years experience. Installer shall be a Company that specializes in product type.

1.8 DELIVERY, STORAGE & HANDLING

- A. Delivery of the materials to the project with the manufacturer’s Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.9 WARRANTY

- A. All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. All workmanship, shall be installed by a certified installer, shall be guaranteed against defects for a period of 1 year from the date of installation. Certificates of warranty shall be provided at project completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Basis of Design is Total Security Solutions as listed below.
 - 1. Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, 866-930-7807. Jim Richards, info@demandtss.com . Web: www.tssbulletproof.com .

2.2 BULLET RESISTANT COMPOSITE (FIBERGLASS) MATERIAL

- A. Composite Panel Product: TSS Total Armor Ballistic Resistant Fiberglass Panel, shall be selected from the chart below. The panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. Fabrication: the technique and materials used shall provide the controlled internal delamination to permit the encapture of the penetrating projectile with Carbide grit edge saw blades. Exposed fasteners shall be non-corrosive.

- a. TSS Total ARMOR Ballistic Resistant Fiberglass Panel TA-3 (Level 3, UL Listed)

TSS BULLET RESISTANT FIBERGLASS PANELS

PRODUCT	TEST CRITERIA/PERFORMANCE LEVEL	BALLISTIC DATA	NOMINAL THICKNESS	LBS/SQ FT
TA-1	UL 752/Level 1 (UL Listed)	9MM, 124 Gr, 1175 Ft. Sec, FMJ	1/4"	2.4
	NIJ 0108.01 / Level IIA	9MM, 124 Gr, 1090 Ft. Sec, FMJ		
TA-2	UL 752/Level 2 (UL Listed)	357 Mag, 158 Gr, 1250 Ft. Sec, LSP	5/16"	3.0
	NIJ 0108.01 / Level II	357 Mag, 158 Gr, 1395 Ft. Sec, JSP		
TA-3	UL 752/Level 3 (UL Listed)	44 Mag, 240 Gr, 1350 Ft. Sec, SWC	1/2"	4.0
	NIJ 0108.01 / Level IIIA	44 Mag, 158 Gr, 1400Ft. Sec, SWC		

2.3 SECURITY LEVEL

- A. The TSS Bullet Resistant Fiberglass will be rated and tested for UL 752 and NIJ—0108.01 at the Level indicated by the product selected.

PART 3 - EXECUTION

3.1 CONTRACT DOCUMENTS

- A. Prior to installing the bullet resistant material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop/CAD drawings, if required.

3.2 INSTALLATION

- A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Prepare all surfaces per recommendations of manufacturer. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb. Fire rated assemblies in accordance with NFPA80.
- B. TSS Bullet Resistant Fiberglass panels can be installed using industrial adhesive, mastic, screws and bolts. Method of application shall maintain bullet resistive rating at junctures with concrete floor, door and window frames and other penetrations. Installation tolerance shall not exceed 1/16th of an inch (1.6mm) for squareness, alignment, twist and plumb. Install hardware as specified.

3.3 JOINTS

- A. All joints shall be reinforced by a back-up layer of bullet resistive material. The bullet resistance of the joint, as reinforced, shall be at least equal to that of the panel. Minimum width of

reinforcing layer shall be 4" (2" on each panel) or a 2" overlap minimum. No rigid high-density material shall be used adjacent to the panel's inner surface, allow 1/4" gap.

3.4 POST APPLICATION

- A. Total Security Solution (TSS) Bullet Resistant Fiberglass Panels shall be installed in accordance with manufacturer's printed recommendations, including adhering to industrial adhesive, mastic, screws, and bolts. Method of application shall maintain the bullet resistive rating at junctures with concrete floor slabs, the concrete roof slabs, the bullet resistive door frames, the bullet resistive window frames and all required penetrations.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements. Clean product and accessories, removing excess sealant, labels and protective covers.
- C. Touch-up, repair or replace damaged products before Substantial Completion.
- D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

END OF SECTION 066700

SECTION 072100 - BUILDING INSULATION**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 072119 "Foamed in Place Insulation"

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter insulation under slabs-on-grade.
 - 2. Cavity-wall insulation.
 - 3. Concealed building insulation.
 - 4. Exposed building insulation.
 - 5. Loose-fill building insulation.
 - 6. Sound attenuation insulation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product test reports.
- D. Research/Evaluation Reports: For foam-plastic insulation.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, IV, 1.60 lb/cu. Ft., with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
1. Manufacturers:
 - a. Basis of Design - Owens Corning. Foamular NGX 250
 - b. DiversiFoil Products.
 - c. Dow Chemical Company.
 - d. Pactiv Building Products Division.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers:
1. CertainTeed Corporation.
 2. Guardian Fiberglass, Inc.
 3. Johns Manville.
 4. Knauf Fiber Glass.
 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation (to be used where insulation is installed in concealed spaces and in substantial contact with the unexposed surface of the ceiling wall or floor surface): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.4 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B.

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate or Angle formed from perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square, welded to projecting copper-coated steel spindle 0.105 inch in diameter and of length capable of holding insulation of thickness indicated securely in position with 1-1/2-inch square or diameter self-locking washers complying with the following requirements:
 - 1. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel sheet, with beveled edge for increased stiffness.
- B. Where anchors are located in ceiling plenums, crawlspace, attic space, or other spaces which can be exposed to human contact, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.
 - 1. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.3 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Use unfaced blanket insulation (when specified) only where insulation is installed in concealed spaces and in substantial contact with the unexposed surface of the ceiling wall or floor surface. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
- D. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Closed-cell spray polyurethane foam.
 - 2. Rated Thermal Barriers
- B. Related Requirements:
 - 1. Division 07 Section Building Insulation

1.3 REFERENCES

- A. American Society for Testing and Materials International (ASTM)
 - 1. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 2. ASTM C 1338: Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
 - 3. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials
 - 4. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
 - 5. ASTM E 2178: Standard Test Method for Air Permeance of Building Materials
 - 6. ASTM E 283: Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

1.4 SUBMITTALS

- A. Product Data for each type of insulation product specified.
- B. Product test reports performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

- C. Evaluation Report: Evidence of compliance of foam-plastic insulations with International Building Code (IBC), International Residential Code (IRC), International Energy Conservation Code (IECC), International Association of Plumbing and Mechanical Officials (IAPMO)
- D. Manufacturer's certificate certifying insulation provided meets or exceeds specified requirements.
- E. Installer's certificate showing certification to install spray foam by designated manufacturer of third-party nationally recognized organization.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Product produced in an ISO 9001 registered factory.
- B. Single Source Responsibility: Single source product from one manufacturer.
- C. Installer Qualifications: Certified by Spray Foam Manufacturer.
- D. Fire-Test-Response Characteristics: Provide materials specified as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84
- E. Toxicity/Hazardous Materials:
 - 1. Provide products that contain no urea-formaldehyde.
 - 2. Products and equipment requiring or using CFCs, HCFCs, or HFCs during the manufacturing or application process will not be permitted.
 - 3. Provide products that contain no PBDEs.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers written instructions for handling and protection prior to and during installation.
- B. Use only those components that are supplied by the Manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch (25.4-mm) thickness of 7.0 deg F x h x sq. ft./Btu at 75 deg F.
 - 1. Products:

- a. Johns Manville Corbond III (or IV where HFO blowing agent is required).
 - b. Carlisle Seal-Tite Pro (HFO where required).
 - c. Huntsman Heatlok Pro (HFO where required). (Basis of Design)
2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2.2 RELATED PRODUCTS

A. 15-Minute Rated Thermal Barriers:

1. Intumescent Paint:
 - a. TPR2 – Thermal/Ignition barrier.
 - b. DC315 – Thermal/ignition barrier.
2. Minimum 1/2 inch gypsum board.

PART 3 - EXECUTION

3.1 PROJECT ENVIRONMENTAL CONDITIONS

- A. Do not apply the SPF below the temperature or above the humidity specified by the manufacturer for ambient air or substrate. If foam is being applied to the metal building's exterior, do not apply the foam during inclement weather.
- B. Do not apply protective coatings when there is ice, frost, surface moisture, or dampness present on the surface to be coated. Prior to applying the coatings, check the polyurethane foam to ensure that the surface is dry. Apply protective coatings in accordance with the coating manufacturer's application instructions.
- C. Apply thermal barriers and vapor retarders in accordance with the manufacturer's application instructions.
- D. Do not expose the SPF to sunlight longer than recommended by the manufacturer.

3.2 SAFETY REQUIREMENTS

- A. Refer to appropriate MSDS for additional safety information.
- B. Before starting to apply SPF or coating, all HVAC equipment on the roof must be turned off. These units and any other potential sources of air entry into the building must be sealed.
- C. Proper disposal of waste materials and containers must be done in compliance with the manufacturer's guidelines or federal, state, and local regulatory agencies.

- D. For protection against exposure to higher levels of pMDI (polymeric methylene diisocyanate) (greater than 1 ppm) or for entry into confined spaces, workers must wear either a self-contained breathing apparatus, with a full face piece, operated in a pressure-demand or other positive-pressure mode; or a combination respirator, including a Type C air-supplied respirator, with a full face piece, operated in a pressure-demand or other positive-pressure mode; and an auxiliary self-contained breathing apparatus, operated in a pressure-demand or other positive-pressure mode.
- E. Installer should acknowledge and follow: CPI Bulletin *MDI-Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal*, Stock Number AX-119.
- F. Personal protective clothing should be worn. This includes wearing the appropriate protective clothing, including eye protection (face shield or chemical worker's goggles), gloves, and coveralls. This is essential to preventing skin exposure and is strongly recommended for most individuals who work with pMDI.

3.3 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

3.4 SUBSTRATE CONSIDERATION AND PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
 - 1. Ensure that penetrating work by other trades is in place and complete.
 - 2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the closed-cell, medium density spray polyurethane foam.
 - 3. Where there are release agents or other non-compatible coatings, wipe down metal surfaces to remove these release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam.
 - 4. When adhesion is in doubt a test spray is recommended to check adhesion.
 - 5. Ensure veneer anchors are in place.
- B. Protection from Spray Applied Materials:
 - 1. Mask and cover adjacent areas to protect from overspray.
 - 2. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
 - 3. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
 - 4. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

3.5 PRIMER APPLICATION

- A. If required, the primer shall be applied to the properly prepared substrate and allowed to cure in accordance with the manufacturer's guidelines.

3.6 SPRAY POLYURETHANE FOAM APPLICATION

- A. The SPF A- and B-components shall be processed in accordance with the manufacturer's instructions.
- B. Polyurethane foam shall be sprayed within the manufacturer's guidelines for temperature, humidity, and other atmospheric conditions. Take precautions to protect surroundings from overspray.
- C. Polyurethane foam shall be sprayed in minimum 1 inch thick passes (lifts), maximum 12 inch passes, until overall thickness is reached based on required R-value. The full thickness of SPF to be applied within any given area should be completed in one day.
- D. Any damage or defects to the polyurethane foam shall be repaired prior to applying protective coatings, vapor retarders, or thermal barriers.
- E. The polyurethane foam surface shall be free of contaminants that will impair adhesion of the protective coatings, vapor retarders, or thermal barriers.

3.7 THERMAL BARRIER APPLICATION

- A. All applied SPF requires a 15- minute-rated thermal barrier. The thermal barrier must be applied in accordance with the manufacturer's guidelines. See drawings for locations where gypsum board does not cover spray foam and intumescent paint is required for the thermal / ignition barrier.

END OF SECTION 072119

SECTION 072732– FLUID-APPLIED MEMBRANE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The work of this section includes, but is not limited to, the following: materials and installation methods for fluid-applied air and vapor barrier membrane system located in the non-accessible part of the wall. Materials and installation methods to bridge and seal the following air leakage pathways and gaps: connections of the walls to the roof air barrier, connections of the walls to the foundations, seismic and expansion joints, openings and penetrations of window frames, store front, and curtain wall, barrier precast cast and other envelope systems, door frames, piping, conduit, duct and similar penetrations, masonry ties, screws, bolts and similar penetrations. All other air leakage pathways in the building envelope.
- B. Related Sections: Other specification sections that directly relate to the works of this section include, but are not limited to, the following:
 - Section 033000 – Cast-In-Place Concrete
 - Section 042000 – Unit Masonry Assemblies
 - Section 079200 – Joint Sealants

1.3 PERFORMANCE REQUIREMENTS

- A. Provide an air and vapor barrier constructed to perform as a continuous air and vapor barrier, and as liquid water drainage plane flashed to discharge any incidental condensation or water penetration.
- B. Air Barriers: The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:
 - 1. It must be continuous, with all joints made airtight.
 - 2. It shall have an air permeability not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water. (1.57 psf.) (equal to 0.02 L/s/m² @ 75 Pa.) when tested in accordance with ASTM E2178-01.

3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be durable or maintainable. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
 - a. Foundation and walls.
 - b. Different wall systems.
 - c. Wall and roof.
 - d. Walls, floors and roof to utility, pipe and duct penetrations.
5. Air barrier penetrations: All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

1.4 REFERENCES

- A. The following standards and publications are applicable to the extent referenced in the text. The most recent version of these standards is implied unless otherwise stated.
 1. American Society for Testing and Materials (ASTM)
 - A 167-96 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - C 836-95 Standard Specification for Cold Liquid Applied Waterproofing Membranes with a Separate Wearing Course
 - D 412-87 Standard Test Methods for Rubber Properties in Tension
 - D 1970-94 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - D 2000-98 Classification System for Rubber Products in Automotive Applications
 - D 2939-94 Standard Test Methods for Emulsified Bitumens Used as Protective Coatings
 - D 3767-92 Standard Practice for Rubber - Measurements of Dimensions
 - E 96-95 Test Methods for Water Vapor Transmission of Materials
 - E 2178-01 Standard Test Method for Air Permeance of Building Materials
 - E 2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- Canadian Construction Materials Centre CCMC Technical Guide 07273 Air Barrier Materials

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, and substrate preparation recommendations. Shop drawings: Show the locations and extent of air and vapor barrier system including details of typical conditions, intersections with other envelope systems and materials, membrane counter-flashings and details showing how gaps in the construction will be bridged and how miscellaneous penetrations such as conduits, pipes, etc. are sealed.
- B. Written documentation: Demonstrate the installer's qualifications under the "Quality Assurance" article.

- C. Samples: Submit representative samples of the following for approval: Cured sample of the fluid-applied, transition, and through-wall flashing membranes, as well as certification by air and vapor barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

1.6 QUALITY ASSURANCE

- A. Manufacturer: Air Air and vapor barrier materials shall be manufactured and marketed by a firm with a minimum of 20 years' experience in the production and sales of waterproofing products. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified. Installer must show evidence of adequate equipment and trained field personnel to successfully complete the project in a timely manner. Both the architect and the air barrier materials manufacturer must approve the installer's credentials.
- B. Installer: The installer shall demonstrate qualifications to perform the work of this Section by submitting the following: Written confirmation or certification from the air barrier manufacturer that the installer has been trained and is recognized by the manufacturer as suitable for the execution of the work. Installer must show evidence of adequate equipment and trained field personnel to successfully complete the project in a timely manner. Both the architect and the air barrier materials manufacturer must approve the installer's credentials.
- C. Materials: Fluid-applied air and vapor barrier material shall be water-based and an elastomeric, single-component, polymer-modified, asphaltic membrane, and contain less than 100 gm/l VOC.
- D. Pre-Installation Conference: 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. Agenda for meeting shall include but not be limited to the following:
 - Review of submittals
 - Review of surface preparation, minimum curing period and installation procedures
 - Review of special details and flashings
 - Sequence of construction, responsibilities and schedule for subsequent operations
 - Review of mock-up requirements
 - Review of inspection, testing, protection and repair procedures
- E. Manufacturer's Representative: Make arrangements necessary to have a trained representative of the manufacturer to review installation procedures. Notify manufacturer's representative not less than 72 hours before meeting is to be held.
- F. Inspection and Testing: Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed air and vapor barrier membrane until any required inspections, testing, and approvals have been completed.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in labeled packages. Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed air and vapor barrier membrane until any required inspections, testing, and approvals have been completed.

1.8 PROJECT CONDITIONS

- A. Apply air barrier within the weather conditions and the range of ambient and substrate temperatures specified by air and vapor manufacturer. Do not apply to a wet or damp substrate. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive the air and vapor barrier membrane.

1.9 WARRANTY

- A. Submit manufacturer's warranty that air and vapor barrier and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications as of the date of product delivery.
- B. Installer to warrant that air and vapor barrier and accessories have been installed in accordance with manufacturer's recommendations, and that air barrier membrane, transition and through-wall flashing membranes, primers, mastics, adhesives and sealants used in this section have been sourced from one manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. For each type of material required for the work of this section, provide primary materials and materials compatible with the air and vapor barrier.

2.2 FLUID-APPLIED AIR BARRIER MEMBRANE

- A. Description: A fluid-applied air and vapor barrier material shall be water-based and an elastomeric, single-component, polymer-modified, asphaltic membrane, and contain less than 100 gm/l VOC.

- B. Performance Requirements:

Property	Test Method	Typical Value
Air Leakage @ 75Pa Differential Pressure	ASTM E 2178-01 CCMC 07273	0.00120 L/s/m ²
Membrane Water Vapor Permeance	ASTM E 96	0.08 perms
Elongation	ASTM D 412	1500%
Chemical Resistance	--	Resists alkalis, mild acids and salt solutions
Color	--	Black
Solids Content	--	62%
Film Thickness	--	60 wet/40 dry
Maximum V.O.C.	--	100 grams/liter

- C. Acceptable Materials: ExoAir 120 fluid-applied air and vapor barrier membrane by Tremco Inc., or approved equal by one of the following:
 - 1. Henry Company
 - 2. W.R. Meadows, Inc

2.3 AUXILIARY MATERIALS

- A. Transition Membrane: Self-adhered air and vapor barrier membrane, 36 mils (.90mm) of self-adhering SBS rubberized asphalt laminated to a 4 mil (.10mm) cross-laminated, high-density polyethylene film with a siliconized release liner. Product shall be: ExoAir 110 and ExoAir 110LT (Low-Temperature) membrane as manufactured by Tremco.
- B. Flashing Membrane: Self-adhered through-wall flashing membrane, 32 mils (.80mm) of self-adhering SBS rubberized asphalt laminated to a 8 mil (.20mm) cross-laminated, high-density polyethylene film with a siliconized release liner. Product shall be: ExoAir™ TWF (Thru-Wall Flashing) membrane as manufactured by Tremco.
- C. Transition and Flashing Membrane Primer: Water-based liquid primer for extruded polystyrene, concrete, masonry, gypsum sheathing, wood, metal, and painted substrates. Product shall be: ExoAir™ 10 WB Primer as manufactured by Tremco.
- D. Transition and Flashing Membrane Primer: Solvent-based liquid primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates. Product shall be: ExoAir 10 Primer™ as manufactured by Tremco.
- E. Butyl-based Self-Adhered Membrane: Transition between air and vapor barrier membrane and TPO or EPDM membranes.
- F. Mastic: Liquid mastic for sealing around brick ties, penetrations and lap and T-joints. Product shall be: ExoAir Termination Mastic, as manufactured by Tremco.
- G. Stainless-Steel Sheet Flashing: ASTM A167, Type 304, soft annealed, with No. 2D finish; minimum, 0.0156 inch (0.4 mm) thick.

PART 3 - INSTALLATION INSTRUCTIONS

Refer to the manufacturer's recommendations for complete installation instructions. Manufacturer's instructions should be strictly adhered to.

3.1 EXAMINATION

- A. The installer shall examine conditions of substrates, areas and other conditions under which air barrier systems will be applied for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Notify the contractor in writing of circumstances detrimental to the proper completion of the work. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. Ensure that:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
 - b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
 - c. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
2. Verify substrate is visibly dry and free of moisture.
 3. Notify Architect in writing of anticipated problems using air barrier over substrate.

3.2 SURFACE PREPARATION

- A. Clean, prepare and treat substrates according to manufacturers' written instructions. Surfaces to be coated must be clean, smooth, firm, free of dust, mud, loose mortar, wires, fins or any other substance that might prevent placement and bonding of a continuous film. Remove contaminants such as grease, oil and wax from exposed surfaces. Use repair materials and methods that are acceptable to manufacturer of the fluid-applied membrane.
- B. Exterior Sheathing Board Joints and Inside/Outside Corners: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws. Seal all joints, screws, etc with ExoAir Termination Mastic and allow sufficient time for the Termination mastic to fully cure before application of fluid-applied membrane. Detail inside and outside corners as above.
 1. Alternate Method - Alternate Method - Exterior Sheathing Board Joints and Inside/Outside Corners: A second method of detailing these conditions can be used in place of the method discussed above. Prime area to be detailed using ExoAir 10 Primer or ExoAir 10 WB Primer and allow to dry. Ensure gypsum sheathing and other substrates receiving ExoAir 110/110LT receive an adequate amount of ExoAir 10 Primer or 10 WB Primer to achieve required bond to substrate. Apply a minimum 3" (75mm) width of ExoAir 110/110LT to the area to be treated. Use a roller to apply pressure to the entire surface to remove all air pockets and assure positive contact to the substrate.
- C. Masonry Substrates: Repair any cracks, voids, and unfilled mortar joints with non-shrinking grout.

3.3 INSTALLATION

- A. Refer to manufacturer's literature for recommendations on installation.
 1. Application of Transition and Through-Wall Flashing Membranes: Apply ExoAir 110/110LT transition, and ExoAir TWF through-wall flashing membranes, before or after application of ExoAir 120 membrane so that the membrane assemblies create a shingle effect from top of the building to the bottom. Prior to the installation of ExoAir 110/110LT and ExoAir TWF, prime area to be detailed using ExoAir 10 Primer or ExoAir 10 WB Primer and allow to dry. Ensure exterior sheathing and other substrates receiving ExoAir 110/110LT receive an adequate amount of primer and/or multiple coats, allowing for complete drying between coats, to achieve required bond to substrate. Install transition membranes at all beams, columns, joints and all windows, doors and penetrations as

- indicated in detail drawings, overlapping edge seams a minimum of 2" (50mm) and end laps a minimum of 4" (128mm).
2. Use Spectrem 1 or other pre-approved Tremco sealant to connect window and curtain wall systems to ExoAir 110/110LT transition membranes or ExoAir TWF.
 3. Use transition membranes to tie into window and doorframes, spandrel panels, floor intersections and changes in substrates. When installing ExoAir TWF, trim bottom edge of ExoAir TWF ½" (13mm) back from exposed face of the wall. ExoAir TWF shall not be permanently exposed to sunlight. Bring ExoAir 110/110LT and ExoAir TWF a minimum of 3" (75mm) onto wall, window, door frame and other substrates. Apply transition and through-wall flashing membranes in appropriate lengths and in such a manner as to ensure continuity of the entire air barrier assembly.
 4. At through-wall flashings, provide an additional 6" (152mm) wide strip of ExoAir TWF to seal top of through-wall flashing to ExoAir 120 installed on substrate. Seal top edge of ExoAir TWF with ExoAir Termination Mastic. Tool the Termination Mastic to ensure it is worked into the surface.
 5. Use pre-cut, easily handled lengths for each location. Remove release paper, position membranes carefully before placing them against the surface. Use a roller to apply pressure to the entire surface to remove all air pockets and assure positive contact to the substrate. Seal the edge with ExoAir Termination Mastic. If a transition membrane is to be attached to ExoAir 120, ExoAir 120 must be cured (16-24 hours and/or firm and dry to the touch) prior to installing the transition membrane.
 6. Prior to completion of the air barrier project work or at the end of each work day, apply ExoAir Termination Mastic to the top edge seam of ExoAir 110/110LT or ExoAir TWF. Tool the ExoAir Termination Mastic to ensure it is worked into the surface.
 7. Coordinate installation of the air barrier system with the roofing trade to ensure continuity / compatibility with the roofing system at this critical transition area. Roofing system should be capped and sealed prior to installation of the air barrier product to prevent moisture on interior and exterior side of the walls that will be treated. Connect the air barrier membrane to adjacent parts of the building envelope such as the roof membrane air barrier, below-grade wall, window and curtain wall systems, and other parts of the building envelope.
 8. Application of Fluid-Applied Membrane: Spray a continuous uniform film of ExoAir 120 at 60 mils (1.5mm) min. wet film thickness using multiple, overlapping passes. When spraying use a cross-hatching technique (alternating horizontal and vertical passes) to ensure even thickness and coverage. When spraying use high pressure, airless spray equipment approved by Tremco. Seal all brick-ties and other penetrations with ExoAir 120 or ExoAir Termination Mastic as appropriate and as work progresses. Carry ExoAir 120 a minimum of 3" (75mm) onto the ExoAir 110/110LT transition and ExoAir TWF membranes. Review final ExoAir 120 application to ensure all substrates have been fully coated, and that there are no passages remaining for air infiltration / exfiltration, water vapor transmission or water penetration.
 9. Inspect the ExoAir 120 membrane before covering and repair any punctures or damaged areas with ExoAir 120, ExoAir Termination Mastic or other pre-approved Tremco sealant, extending repair material a minimum of 4" (152mm) beyond the puncture or damage.
 10. Inspect ExoAir 110/110LT and ExoAir TWF membranes before covering and repair any punctures or damaged areas. Make repairs with ExoAir 110/110LT or ExoAir TWF as appropriate, or ExoAir Termination Mastic, extending either repair material a minimum of 4" (152mm) beyond the puncture or damage.

3.4 PROTECTION AND CLEANING

- A. Remove any masking materials after installation. Clean spillage and soiling on adjacent construction that will be exposed in the finished work using cleaning agents and procedures recommended by manufacturer of the affected construction. Protect membranes to avoid damage from other trades, and construction materials during subsequent operations. Insulation and/or protection products may be installed after all membranes have cured. Schedule work so that the air and vapor barrier system is covered as soon as possible after installation. If the air and vapor barrier system cannot be covered within 30 days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins or contact manufacturer for additional recommendations.

END OF SECTION 072720

SECTION 074113 - METAL ROOF PANELS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Refer to Division 6 Section "Rough Carpentry" for nail based insulation used in conjunction as a separate layer from the Polyisocyanurate in this section. Refer to drawings for thicknesses.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Factory-formed and field-assembled and mechanically seamed, standing-seam metal roof panels.
 - 2. Metal soffit panels.
 - 3. Snow retention system
- B. Steel Sheet Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Uplift Resistance: Comply with UL 580 for wind-uplift resistance class indicated.
- B. Structural Performance: Capable of withstanding the effects of gravity loads and the following loads and stresses, based on testing according to ASTM E 1592:
 - 1. Wind Loads: Minimum design wind pressures indicated on the structural drawings, but not less than 15 lbf/sq. ft., acting inward or outward.
 - 2. Snow Loads: Comply with loading requirements indicated on structural drawings, but not less than 20 lbf/sq. ft.
 - 3. Deflection Limits: Vertical deflections no greater than 1/180 of the span.
- C. Thermal Resistance Value of insulation boards: Where R-values are noted, the value shall be measured as Long Term Thermal Resistance (LTTR) in conformance with CAN/ULC S770 which is included in ASTM 1289.

1.5 SUBMITTALS

- A. Product Data: For each type of metal roof panel and accessory indicated.
- B. Shop Drawings: Show layouts of metal roof panels, including plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories.
 - 2. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Coordination Drawings: Drawn to scale and coordinating metal roof panel installation with penetrations and roof-mounted items.
- D. Samples: For each exposed finish.
- E. Material certificates.
- F. Field quality-control inspection reports.
- G. Product test reports.
- H. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.
- C. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Warranty on materials and installation: Manufacturer to provide a written no dollar limit (NDL) warranty for Twenty (20) years from the date of final completion of the roof and acceptance, guaranteeing materials and workmanship for watertightness, weathertightness and against all leaks.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or equal.

2.2 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Surface: Smooth, flat finish with Striations.
 - 3. Exposed Finishes:
 - a. High-Performance Organic Finish: Two-coat, thermocured system with fluoropolymer coats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2604, except as modified below:
 - 1) Humidity Resistance: 2000 hours.
 - 2) Salt-Spray Resistance: 2000 hours.
- B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; as recommended in writing by metal roof panel manufacturer.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.
- B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

2.4 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade II, 20 psi, felt or glass-fiber mat facer on both major surfaces. R-30

2.5 SUBSTRATE BOARD

- A. Cover Board: ASTM C 1278, water-resistant gypsum substrate, 1/2 inch (13 mm) thick.
 1. USG Securock- Gypsum Fiber Reinforced, 1800 psi compressive strength
 2. Dens Deck Prime gypsum board 900 compressive strength
- B. Substrate-Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FMG 4470, designed for fastening substrate board to substrate.

2.6 MISCELLANEOUS METAL FRAMING

- A. General: Comply with ASTM C 754 for conditions indicated.
 1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

2.7 SNOW RETENTION SYSTEM

- A. Continuous Snow Retention System: Snow slide prevention system clamped to standing seams of metal roof panels. (One row system is indicated on drawings. Verify with manufacturer if additional rails are required for project location.)
- B. Basis of Design Product: Subject to compliance with requirements, S-5! Colorgard (Metal Roof Innovations, Ltd., 8655 Table Butte Rd.; Colorado Springs, CO 80908; Ph 719-495-0518), or comparable product.
- C. Accessories:
 1. Provide color strip to match metal roof panel color / finish.

2. Provide "SnapClip" to retard migration of snow and ice beneath crossmembers as recommended per metal roof panel seam height.
 3. Provide S-5! clamp / bracket as required by manufacturer for snow retention system installation on specific metal roof panels
- D. Location: Install above all gutters and vehicular / pedestrian walkways as shown in drawings and per manufacturer's recommendation.
- E. Installation: Per manufacturer's recommendations.

2.8 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
1. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.9 METAL ROOF PANELS

- A. Standing-Seam Metal Roof Panels: Factory-formed, designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
1. Steel Panel Systems: Comply with ASTM E 1514.
 - a. Basis of Design Product: Englert A1300 Metal Roof Mechanically Seamed Panel System or approved equal product.
 2. Type: 16" wide, vertical rib, seamed joint, as indicated on Drawings.
 3. Material: Metallic-coated steel sheet, 24 ga.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: Dark Bronze
 4. Clips: Floating to accommodate thermal movement.
 - a. Material: Stainless-steel sheet.
 5. Joint Type: As standard with manufacturer.
 6. Uplift Rating: UL 90.

2.10 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels:
 - 1. Not all manufacturers offer all profiles, materials, and sizes of metal soffit panels. Basis of Design Product for the under canopy areas : Firestone UNA-CLAD UC-500 System or approved equal product.
 - 2. Type: 8" wide.
 - 3. Profile: Flush.
 - 4. Material: Metallic-coated steel sheet, 24 ga.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: Dark Bronze

2.11 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 - 2. Clips: Minimum 16 ga, stainless-steel panel clips designed to withstand negative-load requirements.
 - 3. Cleats: Mechanically seamed cleats formed from minimum 26 ga, stainless-steel or nylon-coated aluminum sheet.
- B. Flashing and Trim: Formed from 24 ga, metallic-coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- C. Gutters: Formed from 20 ga- thick, metallic-coated steel sheet. Match profile on Drawings, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Join sections with riveted end soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Furnish gutter supports spaced 36 inches o.c., fabricated from same color metal as gutters and to be 3/16" x 1" for gutters up to 20" wide. Provide a continuous reinforcing bar of same material as the gutter a minimum 1" wide and 1/8" thick. Provide aluminum wire ball strainers at outlets. Finish gutters to match metal roof panels or color selected by Architect from full range of manufacturer's standard colors.

1. Install gutters with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.
- D. Downspouts: Formed from 22 ga- thick, metallic-coated steel sheet; in 10-foot- long sections, complete with formed elbows and offsets. Join sections with 1-1/2 inch telescoping joints. Provide fasteners designed to hold downspout securely 1 inch away from walls; Locate fasteners at top and bottom and at approximately 60 inches o.c. in between. Finish downspouts to match metal roof panels or color selected by Architect from full range of manufacturer's standard colors.

2.12 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
- E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Substrate Board: Install substrate boards over roof deck or sheathing, (see drawings) on entire roof surface. Attach with substrate-board fasteners.
 1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 2. Comply with UL requirements for fire-rated construction.
- B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Comply with temperature restrictions of underlayment

manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof, in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

- B. At soldered locations, apply slip sheet over underlayment before installing metal roof panels.

3.3 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- C. Install multiple layers of insulation under area of roofing to achieve required thickness. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting of metal roof panels by torch is not permitted.
 - 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
 - 3. Provide metal closures at rake edges.
 - 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 6. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
- B. Fasteners:
 - 1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
 1. Install clips to supports with self-tapping fasteners.
- B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
 1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

3.6 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored straps spaced not more than 32 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.

3.7 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 3. Provide elbows at base of downspouts to direct water away from building, where not piped.
 4. Tie downspouts to underground drainage system.

3.8 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113

SECTION 078413 - THROUGH-PENETRATION FIRESTOP SYSTEMS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both blank openings and openings containing penetrating items.
 - 1. Installation Responsibility: Assign installation of UL rated through-penetration firestop systems in Project to the installing Subcontractors for any of the items of their work that penetrate fire rated assemblies.

1.4 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both blank openings and openings containing penetrating items. Provide through-penetration firestop systems that are installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 (Standard Method of Fire Tests of Through Penetration Fire Stops) or UL 1479 (Fire Tests of Through-Penetration Firestops):
- C. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- D. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistance-rated shaft enclosures.

- E. W-Rated Systems: Where through-penetration firestop systems require water resistance, provide through-penetration firestop systems with Class 1 L-ratings in accordance with water leakage test per UL 1479.
- F. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - a. Mold Resistance: Provide penetration firestoppping with mold and mildew resistance rating of 0 as determined by ASTM G21.
 - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- G. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 01300.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Submit material safety data sheets provided with product delivered to jobsite.

1.6 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- B. Installer Qualifications:

1. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
 2. The work is to be installed by a contractor with at least one of the following qualifications:
 - a. FM 4991 Approved Contractor
 - b. UL Approved Contractor
 - c. Fire stop specialty contractor trained and accredited by the firestopping manufacturer.
 3. Firm with not less than 3 years experience with fire stop installation.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
- D. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
- E. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.
- F. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- G. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- H. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.
- I. Firestop systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- J. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International firestop council.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials undamaged in manufacturers clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide through-penetration firestop systems by **Hilti, Inc.**, or equivalent products for each that are produced by one of the following manufacturers:
 - 1. Tremco Fire Protection Systems Group
 - 2. AD Fire Protection Systems
 - 3. 3M Fire Protection Products
 - 4. RectorSeal (Metacaulk products)

2.2 PRODUCTS

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
- C. Firestopping Materials may be either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.
- D. Use only firestop products that have been UL 1479 or ASTM E 814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
 - 1. Hilti Firestop Block (CFS-BL)
- E. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - 1. Hilti FS-ONE MAX Intumescent Firestop Sealant

2. Hilti CFS-S-SIL-SL Self-leveling Firestop Silicone Sealant
 3. Hilti CP 620 Fire Foam
 4. Hilti CP606 Flexible Firestop Sealant
 5. Hilti CFS-S-SIL-GG Gun Grade Firestop Silicone Sealant
- F. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
1. Hilti CFS-S-SIL-GG Gun Grade Firestop Silicone Sealant
 2. Hilti CP 606 Flexible Firestop Sealant
 3. Hilti FS-ONE MAX Intumescent Firestop Sealant
- G. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
1. Hilti FS-ONE MAX Intumescent Firestop Sealant
- H. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti FS-ONE MAX Intumescent Firestop Sealant
 2. Hilti CP 620 Fire Foam
 3. Hilti CFS-S-SIL-GG Gun Grade Firestop Silicone Sealant
 4. Hilti CP 606 Flexible Firestop Sealant
- I. Non- curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti CP 618 Firestop Putty Stick
 2. Hilti CFS-PL Firestop Plug
- J. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
1. Hilti CFS-P PA Firestop Putty Pad
 2. Hilti Firestop Box Insert
- K. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
1. Hilti CP 643N Firestop Collar
 2. Hilti CP 644 Firestop Collar
 3. Hilti CP 648-E/648-S Wrap Strips
- L. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti CP 637 Firestop Mortar
 2. Hilti CFS-BL FIRE BLOCK
 3. Hilti CP 620 Fire Foam
- M. Non- curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti CFS-BL FIRE BLOCK
 2. Hilti CP 675T Firestop Plug

- N. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
 - 1. Hilti CFS-BL FIRE BLOCK
 - 2. Hilti CFS-PL Firestop Plug
- O. Re-penetrable, cable management products for use with new cable bundles penetrating gypsum or masonry walls, the following products are acceptable:
 - 1. Hilti CP 653 Speed Sleeve for opening equal to or less than 4" diameter
 - 2. Hilti CFS-BL Firestop Block for openings larger than 4" diameter
 - 3. Hilti CFS-SL GP Gang plate for use with multiple cable management devices
- P. Firestop system with a "F" Rating as determined by UL 1479 or ASTM E 814 which is equal to the time rating of construction being penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
 - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - 5. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration materials.
 - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.
- C. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
 - 1. Installation of Firestop shall be performed by either a specialty contractor specializing in firestop application (FM G 4991 or UL Qualified Firestop Contractor), or general or sub-

- contractors with experience in similar applications and projects with installers qualified, trained, and certified by the firestop manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply Firestop in accordance with fire test reports, fire resistance requirements, acceptable sample installations and manufacturer's recommendations.
 3. Coordinate with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire rated construction have been permanently installed prior to installation of Firestop, schedule and sequence work to assure that partitions and other construction, which would conceal penetrations, are not erected prior to the installation of Firestop.
- D. Install forming/damming/backing 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 indicated.

After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

1. Install dams when required to properly contain Fire stopping materials within openings and as required to achieve required fire resistance rating. Combustible damming material must be removed after appropriate curing. Incombustible damming materials may be left as a permanent component of the Firestop system.
- E. Install fill materials for firestop systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- F. Identification: Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. Include the following information on labels:
1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
 4. System number
 5. Date of installation.
 6. Through-penetration firestop system manufacturer's name.
 7. Installer's name.
- G. Building Exterior Perimeters:
1. Where exterior facing construction is continuous past a structural floor, and a space would otherwise remain open between the inner face of the wall construction and the outer perimeter edge of the structural floor, provide fire stopping to equal the fire resistance of

the floor assembly. Mineral wool by itself is not an acceptable firestop, neither is mineral wool used with beads of caulking applied along length of mineral wool/curtain wall or mineral wool/floor slab junctures. If mineral wool is part of firestop system, the mineral wool must be completely covered by appropriate thickness of UL Listed Firestop Sealant, in accordance to building code and ASTM E 2307 testing standard.

2. Fire stopping shall be provided whether or not there are any clips, angles, plates, or other members bridging or interconnecting the facing and floor systems, and whether or not such items are continuous.
3. Where an exterior wall of composite type construction passes a perimeter structural member, such as a girder, beam, or strut, and the finish on the interior wall face does not continue in proximity with the underside of the structural floor above, thus interrupting the fire-resistive integrity of the wall system, and a space would otherwise remain open between the interior face of the wall and lower edge of the structural member; provide fire stopping to continuously fill such open space.
4. Perimeter firestop systems must match exactly to installation conditions, systems that are not tested to ASTM E 2307 standard will not be accepted.
5. For exterior cladding designs that provide floor to ceiling vision glass, systems CAJ 527p or CAJ 528p shall be installed.

H. Interior Walls and Partitions:

1. All fire rated interior joint, gap and linear openings are required to be fire stopped in accordance with ASTM E 1966 and UL 2079.
2. Fire rated construction joints must have a minimum class II movement capability of 12% compression and extension as tested by ASTM E 1399, unless stated to have greater requirements for movement.
3. Exception: Bottom of wall joints may have static joint firestop systems as tested by UL 2079 or ASTM E 1966.
4. Where a wall or partition is continuous past a structural floor, such as a stairwell and vertical shafts, and a space would otherwise remain open between the wall face and perimeter edges of the adjoining structural floor provide fire stopping.
5. Provide fire stopping whether or not there are any clips, angles, plates, or other members bridging or interconnecting the wall and floor systems, and whether or not such items are continuous.
6. Where the top edge of a fire-rated wall or partition abuts and is at right angles to fluted-type metal decking, and the construction is such that would otherwise leave the flute spaces open, provide fire stopping.

I. Penetrations:

1. Penetrations include conduit, cable, wire, pipe, duct, or other elements which pass through one or both sides of a fire rated floor, wall, or partition. Except for floors on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide fire stopping to fill such spaces in accordance with ASTM E 814 and UL 1479.
2. Where penetrations occur at fire-rated walls or partitions of solid-type construction, provide fire-stopping to completely fill spaces around the penetration, in accordance with ASTM E 814 and UL 1479. Where penetrations occur at fire-rated walls or partitions of hollow-type construction, provide fire stopping to completely fill spaces around the penetration, on each side of the wall or partition, in accordance with ASTM E 814 and UL 1479.

3. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space - if any - between sleeve and wall of opening.
- J. Construction Joints:
1. Where openings occur for expansion, at intersections of dissimilar rated construction, or control joints provide a rated joint system in accordance with ASTM E 1966 or UL 2079.
 2. Fire-resistant joint systems shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases.
 3. Fire-resistant joint systems shall be tested in accordance with the requirements of either ASTM E 1966 or UL 2079. Nonsymmetrical wall joint systems shall be tested with both faces exposed to the furnace, and the assigned fire-resistance rating shall be the shortest duration obtained from the two tests.
- K. Cable Transit Devices:
1. Cable transit device or cable pass through device (cable sleeve) must have ASTM E814 and UL1479 tested F ratings equal to the penetrated assembly, and L ratings of <5cfm at 0% through 100% visual fill.
 2. Cable transit device must be a standalone firestop system capable of new installation of cables and retrofit installation for existing cables with same device.
 3. Cable transit device must not apply mechanical pressure, pinch, or twist penetrating cables or items.
 4. Cable transit device must have approved UL systems for high voltage cable, conduit, EMT, metal pipes, PVC, and CPVC penetrations.
 5. Cable transit device must allow for 100% visual fill of cable installation.
 6. Approved cable transit devices must be available in round as well as square configurations, where round devices can be installed inside of metallic conduit.
 7. Cable transit devices must be available with pre- manufactured brackets allowing single, double, triple, and six gang installation of cable transit devices.
- L. Provide fire stopping to fill miscellaneous voids and openings in fire-rated construction in a manner essentially the same as specified herein before:

3.3 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage an independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.4 COORDINATION

- A. Coordinate construction of openings, penetrations and construction joints to ensure that the fire stop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems. Coordinate construction and sizing of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- C. Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.
- D. Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

3.5 SYSTEM SCHEDULE

CONCRETE FLOORS			CONCRETE OR BLOCK WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM
CIRCULAR BLANK OPENINGS	1	F-A-0006, C-AJ-0055, C-AJ-0090	CIRCULAR BLANK OPENINGS	1	C-AJ-0055, C-AJ-0090
	2	F-A-0006, C-AJ-0055, C-AJ-0090		2	C-AJ-0055, C-AJ-0090
	3	F-A-0006, C-AJ-0055, C-AJ-0086		3	C-AJ-0055, C-AJ-0086
SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, F-A-1028, F-A-1017	SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, W-J-1067, W-J-1020
	2	C-AJ-1226, F-A-1028, F-A-1017		2	C-AJ-1226, W-J-1067, W-J-1020, W-J-1248
	3	C-AJ-1226, F-A-1017		3	C-AJ-1226, W-J-1041, W-J-1068
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	4	C-BJ-1037, C-BJ-1034	SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	4	C-BJ-1034, C-BJ-1037, W-J-1041, W-J-1042, W-J-1068
	1	F-A-2053, F-A-2025, C-AJ-2109, C-AJ-2098, C-AJ-2271, C-AJ-2167		1	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2342
	2	C-AJ-2098, C-AJ-2271, C-AJ-2167, C-BJ-2021, C-AJ-2371, C-AJ-2342		2	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
SINGLE/CABLE BUNDLES	3	F-A-2054, C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342	SINGLE/CABLE BUNDLES	3	C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342
	4	C-BJ-2016, C-AJ-2017		4	W-J-2057, W-J-2091
	1	F-A-3007, C-AJ-3095, C-AJ-3180, C-AJ-3283	SINGLE/CABLE BUNDLES	1	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167
CABLE TRAY	2	F-A-3007, C-AJ-3095, C-AJ-3334, F-A-3060		2	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167, W-J-3169
	3	F-A-3007, C-AJ-3095, C-AJ-3285		3	C-AJ-3095, C-AJ-3180, W-J-3167
SINGLE INSULATED PIPES	4	C-AJ-4034, C-AJ-4035	CABLE TRAY	4	W-J-3050
	1	C-AJ-4034, C-AJ-4035		1	W-J-4027, C-AJ-4034, C-AJ-4035
	2	C-AJ-4034, C-AJ-4035		2	W-J-4027, C-AJ-4034, C-AJ-4035
ELECTRICAL BUSWAY	3	C-AJ-4034, C-AJ-4035		3	C-AJ-4034, C-AJ-4035
	1	F-A-5015, F-A-5017, C-AJ-5090, C-AJ-5091, C-AJ-5090, C-AJ-5048	SINGLE INSULATED PIPES	4	W-J-8007
	2	F-A-5015, F-A-5017, C-AJ-5090, C-AJ-5091, C-AJ-5090		1	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	3	F-A-5016, C-AJ-5090, F-A-5018		2	C-AJ-5090, C-AJ-5061
	4	C-BJ-5006	ELECTRICAL BUSWAY	3	C-BJ-5006, W-J-5028
	1	C-AJ-6006, C-AJ-6017, F-A-6002, C-AJ-6036		4	C-AJ-6006, C-AJ-6017, C-AJ-6036
MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	2	C-AJ-6006, C-AJ-6017, F-A-6042, C-AJ-6036		1	C-AJ-6006, C-AJ-6017, C-AJ-6036
	3	C-AJ-6006, C-AJ-6017	MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	2	C-AJ-6006, C-AJ-6017
	1	C-AJ-7046, C-AJ-7051, C-AJ-7084		3	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
MIXED PENETRANTS	2	C-AJ-7046, C-AJ-7051, C-AJ-7085		2	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
	3	C-AJ-7046, C-AJ-7051	MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	3	C-AJ-7046, C-AJ-7051
	N/A**	N/A**		1	W-J-7029, W-J-7124
WOOD FLOORS	1	C-AJ-8099, C-AJ-8056, C-AJ-8143		2	W-J-7091, W-J-7112, W-J-7124
	2	C-AJ-8099, C-AJ-8056, C-AJ-8143	MIXED PENETRANTS	1	C-AJ-8099, C-AJ-8056, W-J-8007, C-AJ-8143
	3	C-AJ-8099, C-AJ-8056		2	C-AJ-8099, C-AJ-8056, W-J-8007, C-AJ-8143
GYPSUM WALLS	4	C-AJ-8095		3	C-AJ-8041, C-AJ-8056, W-J-8007, C-AJ-8099
	1	F-C-1009, F-C-1059, F-C-1168		4	C-AJ-8095, W-J-8007
	2	F-C-1009, F-C-1059, F-C-1168	METAL PIPES OR CONDUIT	1	W-L-1054, W-L-1058, W-L-1164, W-L-1506
NON-METALLIC PIPE OR CONDUIT	1	F-C-2232, F-C-2030, F-C-2160, F-C-2389		2	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	2	F-C-2029, F-C-2030, F-C-2128, F-C-2160		4	W-L-1110, W-L-1111, W-L-1165
SINGLE OR BUNDLED CABLES	1	F-C-3012, F-C-3110, F-C-3044	NON-METALLIC PIPE OR CONDUIT	1	W-L-2078, W-L-2075, W-L-2128
	2	F-C-3012, F-C-3110		2	W-L-2078, W-L-2075, W-L-2128
	1	F-C-3012, F-C-3110, F-C-3044		4	W-L-2184, W-L-2245
INSULATED PIPES	1	F-C-5004, F-C-5037, F-C-5036	SINGLE OR BUNDLED CABLES	1	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	2	F-C-5004, F-C-5037		2	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	1	F-C-7013		3	W-L-3385, W-L-3277
NON-INSULATED MECHANICAL DUCTWORK WITHOUT	1	F-C-7013	CABLE TRAY	4	W-L-3139, W-L-3334
	2	F-C-7013		1	W-L-4011, W-L-4019, W-L-4081
	1	F-C-7013		2	W-L-4011, W-L-4019, W-L-4081
WOOD FLOORS	1	F-C-5004, F-C-5037, F-C-5036	INSULATED PIPES	4	W-L-8014
	2	F-C-5004, F-C-5037		1	W-L-5028, W-L-5029, W-L-5047
	1	F-C-7013		2	W-L-5028, W-L-5029, W-L-5047
GYPSUM WALLS	1	F-C-7013		4	W-L-5073
	2	F-C-7013	NON-INSULATED MECHANICAL DUCTWORK WITHOUT	1	W-L-7017, W-L-7040, W-L-7042, W-L-7155
	1	F-C-7013		2	W-L-7040, W-L-7042, W-L-7155

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
 - 1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 2. Exterior joints in horizontal traffic surfaces.
 - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 4. Interior joints in horizontal traffic surfaces.
- B. See Division 3 Section "Cast-in-Place Concrete" or Structural Drawings for semi-rigid epoxy joint filler in floor slabs.
- C. See Division 8 Section "Glazing" for glazing sealants.
- D. See Division 7 Section "Sheet Metal Flashing and Trim" for sealing joints in interior and exterior sheet metal.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.5 SUBMITTALS

- A. Qualification Data: For qualified applicator.

- B. Product Data: For each joint-sealant product indicated.
- C. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- E. Compatibility and adhesion test reports.
- F. Product certificates.
- G. Warranties.

1.6 QUALITY ASSURANCE

- A. All joint sealants installed as part of the building envelope air and moisture barrier system shall be installed by a single qualified installer.
 - 1. Installer Qualifications: Experienced Installer equipped and trained for application of joint sealants required for this Project with record of successful completion of projects of similar scope.
- B. Single Source Responsibility: Provide exterior joint sealants by a single manufacturer responsible for testing of Project substrates to verify compatibility and adhesion of joint sealants.
- C. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.
- E. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
 - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed or approved equal.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Sealant Type 1:
 - 1. For exterior and interior joints in horizontal and sloped traffic surfaces such as, but not limited to:
 - a. Control, expansion and isolation joints in cast-in-place concrete.
 - b. Tile control and expansion joints.
 - c. Joints between different materials listed above.

2. Provide single-component or multi-component polyurethane sealant having a Shore A hardness of not less than 15 or more than 50 and plus-or-minus 25 percent joint movement capability; comply with ASTM C920, Type S or M, Grade P or NS, Class 25.
 - a. Tremco; THC-900/901.
 - b. Tremco; Vulkem 45 SSL.
 - c. Bostik Findley; Chem-Calk 550.
 - d. Meadows, W. R., Inc.; POURTHANE.
 - e. Pacific Polymers, Inc.; Elasto-Thane 227 High Shore Type I (Self Leveling).
 - f. Pacific Polymers, Inc.; Elasto-Thane 227 Type I (Self Leveling).
 - g. Pecora Corporation; Urexpan NR-200.
 - h. Sika Corporation; Sikaflex 2c NS EZ Mix (2-component)
- D. Sealant Type 2:
1. For exterior joints in vertical surfaces and non-traffic horizontal surfaces such as, but not limited to:
 - a. Control and expansion joints in cast-in-place concrete.
 2. For interior joints in vertical surfaces and non-traffic horizontal surfaces such as, but not limited to:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeters joints on exposed interior surfaces of exterior openings.
 - c. Trim or finish joints subject to movement.
 3. Provide single-component or multi-component, low-modulus, non-sag sealant: comply with ASTM C920, Type S or M, Grade NS, Class 25. (Class 50), Class 100/50.
 - a. Single Component Urethane – (Type 2)
 - i. Sika Corporation, Inc.; Sikaflex - 1a.
 - ii. Sika Corporation, Inc.; Sikaflex – 15LM.
 - iii. Sika Corporation; SikaHyflex 150
 - iv. Sonneborn, Division of ChemRex Inc.; Ultra.
 - v. Sonneborn, Division of ChemRex Inc.; NP 1.
 - vi. Tremco; Vulkem 116.
 - vii. Tremco; DyMonic FC.
 - b. Multi Component Urethane – (Type 2M)
 - i. Tremco; Dymeric 240FC
 - ii. Sika Corporation, Inc.; Sikaflex - 2c NS EZ Mix.
 - iii. BASF; MasterSeal NP 2.
- A. Sealant Type 3:
1. For exterior joints in vertical surfaces and non-traffic horizontal surfaces such as, but not limited to:
 - a. Control and expansion joints in unit masonry and stone trim. (Type 2M only)
 - b. Perimeter joints between materials listed above and frames of doors, windows, storefronts, louvers and similar openings.
 2. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.; select color from listing of those approved.
 3. Acceptable Silicone Sealants:
 - a. ADFAST, Adseal 4580 Series
 - b. Dow Corning Corporation; 991 Silicone High Performance Sealant.
 - c. Tremco; Spectrem 3

B. Sealant Type 4:

1. For interior joints in vertical and horizontal surfaces where incidental food contact may occur.
2. Provide single component or multi-component sealant complying United States Department of Agriculture (USDA) guidelines for incidental food contact, with the cured sealant; comply with ASTM C920, Type S or M, Grade P or NS, Class 25; select color from listing of those approved.
3. Acceptable Silicone Sealants:
 - a. Dow Corning Corporation; 799.
 - b. GE Silicones; UltraGlaze SSG4000.
 - c. GE Silicones; UltraGlaze SSG4000AC.
 - d. Tremco; Proglaze SG.
 - e. Tremco; Spectrem 2.
 - f. Tremco; Tremsil 600.
 - g. Sika Corporation; Sikaflex 1a
 - h. Sika Corporation; Sikaflex 2c NS EZ Mix

C. Sealant Type 5:

1. For exterior joints under metal thresholds and saddles.
2. Acceptable products:
 - a. Bostik Findley; Bostik 300.
 - b. Pecora Corporation; BC-158.
 - c. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
 - d. Tremco; Tremco Butyl Sealant.

D. Sealant Type 6:

1. For interior joints between plumbing fixtures and adjoining walls, floors and counters.
2. Single-Component Mildew-Resistant Neutral or Acid-Curing Silicone Sealant, Type S, Grade NS, Class 25, Exposure NT:
 - a. Adfast; Adseal 4800 Series
 - b. Pecora Corporation; 898.
 - c. Tremco; Tremsil 600 White.
 - d. Dow Corning Corporation; 786 Mildew Resistant.
 - e. GE Silicones; Sanitary SCS1700.
 - f. Tremco; Tremsil 200

2.4 LATEX JOINT SEALANTS

A. Sealant Type 7:

1. For exposed interior joints in vertical surfaces and non-traffic horizontal surfaces, involving joint movement of not more than plus or minus 5 percent such as, but not limited to:
 - a. Perimeter joints between interior wall surfaces and frames of interior doors, windows, storefronts, louvers, elevator entrances and similar openings.
 - b. Trim or finish joints.
2. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.
 - a. Adfast: Adseal 1070 Series
 - b. Bostik Findley; Chem-Calk 600.
 - c. Pecora Corporation; AC-20+.

- d. Schnee-Morehead, Inc.; SM 8200.
- e. Sonneborn, Division of ChemRex Inc.; Sonolac.
- f. Tremco; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.6 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 2. Remove laitance and form-release agents from concrete.
 - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.
- H. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 079200

SECTION 081113 – HOLLOW METAL DOORS AND FRAMES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes standard hollow-metal steel doors and frames.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance and temperature-rise ratings, and finishes for each type of steel door and frame specified.
- B. Shop Drawings: Provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings.
- C. Product test reports.

1.5 QUALITY ASSURANCE

- A. Fire-Rated Door, Sidelight and Transom Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
 - 1. Test Pressure: Test according to locally accepted standards - NFPA 252 or UL 10C, or UBC Standard 7-2. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
 - 2. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.
- B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to locally accepted standards - NFPA 257 or UL 9, or UBC Standard 7-4. Label each individual glazed lite.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld Building Products, LLC.
 - 2. Ceco Door Products; an ASSA ABLOY Group Company.
 - 3. CURRIES Company; an ASSA ABLOY Group Company.
 - 4. Kewanee Corporation (The).
 - 5. Mesker Door Inc.
 - 6. Republic Builders Products Company.
 - 7. Steelcraft; an Ingersoll-Rand Company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.
- D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.
- E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- G. 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 standard steel door frames of type indicated.
- H. Grout: Comply with ASTM C 476, with a slump of 4 inches (102 mm) for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.

- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- J. Glazing: Comply with requirements in Division 8 Section "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces. Comply with ANSI A250.8.
 - 1. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
 - 2. Vertical Edges for Single-Acting Doors: Square edge
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm) at strike side of pairs of doors.
 - 3. Top and Bottom Edges: Closed with flush 0.0598 inch or 16 gage thick end closures or channels of same material as face sheets.
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 3 (0.0598 inch or 16 gage) and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush)
 - 2. The exterior hollow metal doors shall be insulated and galvanized.
 - 3. R-Value shall be minimum of 6.0 for polystyrene core. R-Value shall be minimum of 10.0 for polyurethane core.
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 2 (0.047 inch or 18 gage) and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush)

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 2. Frames for Level 3 Exterior Steel Doors: Minimum .0747" or 14 gage thick steel sheet.
 3. Exterior frames shall be galvanized.
 4. Exterior frames to have 0.149 inch or 9 gage hinge reinforcement plates for strikes and each 4-1/2" x 4-1/2" template type hinge, projection welded to frame.
 5. Provide 0.104 inch or 12 gage reinforcement plate for surface mounted closer.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 2. Frames for Level 3 Interior Steel or Wood Doors and Borrowed Lights: Minimum .0598" or 16 gage thick steel sheet.
- D. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- E. Jamb Anchors: Masonry, stud-wall, compression, or postinstalled expansion type; not less than 0.042 inch or 19 gage thick.
- F. Floor Anchors: Formed from same material as frames, not less than 0.042 inch or 19 gage thick.
- G. Plaster Guards: Formed from same material as frames, not less than 0.016-inch or 26 gage thick. Provide behind hinges, strikes, and attachment points for other required door hardware for frames set in masonry or plaster walls and frames to be grouted.
- H. Door Silencers: 3 silencers on single door frames, 2-silencers on double-door frames.

2.5 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch or 20 gage thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch or 20 gage thick, fabricated from same material as frames in which they are installed.

2.6 FABRICATION

- A. General: Fabricate standard steel doors and 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.
- B. Standard Steel Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Glazed Lites: Factory cut openings in doors.
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 6. Jamb Anchors: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c.
 7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
- D. Hardware Preparation: Factory prepare standard steel doors and 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 Division 8 Section "Door Hardware."
1. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide fixed stops and moldings welded on secure side of door or frame.
 2. Provide loose stops and moldings on inside of doors and frames.
- 2.7 FINISHES
- A. Steel Finish: Factory priming for field-painted finish.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Remove welded-in shipping spreaders installed at factory.
- B. Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- C. Standard Steel Frames: Install standard steel frames for doors, sidelights, transoms, borrowed lights and other openings, of size and profile indicated. Comply with SDI 105.
 - 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. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
 - 2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
- D. Standard Steel Doors: Fit hollow-metal doors accurately in frames. Shim as necessary.
 - 1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- E. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.
- F. Anchors: Conceal exposed fasteners in frames with automotive body filler. Sand smooth prior to painting.
- G. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- H. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes solid-core doors as follows:
 - 1. Solid-core doors with wood-veneer faces and factory finishing.
 - 1. Factory fitting wood doors to frames and factory machining for hardware.
 - 2. See Division 8 Section "Glazing" for glass view panels in flush wood doors.

1.4 SUBMITTALS

- A. Product Data: For each type of door and include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details; location and extent of hardware blocking; holes, and cutouts; requirements for veneer matching; factory finishing; fire ratings; and other pertinent data.
- C. Samples: For each face material and finish.

1.5 QUALITY ASSURANCE

- A. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
- B. Fire-Rated Wood Doors: Doors that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch length.
 - 1. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods Inc.
 - 2. Eggers Industries; Architectural Door Division.
 - 3. GRAHAM Manufacturing Corp.
 - 4. Marshfield Door Systems, Inc.
 - 5. Mohawk Flush Doors, Inc.
 - 6. Oshkosh Door Company.
 - 7. VT Industries, Inc.

2.2 DOOR CONSTRUCTION

- A. Doors for Transparent Finish:
 - 1. Grade: Premium, with Grade AA faces
 - 2. Species and Cut: As noted on drawings and Finish specifications.
 - 3. Match between Veneer Leaves: Book match.
 - 4. Assembly of Veneer Leaves on Door Faces: Balance match.
 - 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
- B. Interior Veneer-Faced Solid-Core Doors:
 - 1. Core: Particleboard.
 - 2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
 - 3. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 4. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- C. Fire-Rated Doors:
 - 1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.

2. Edge Construction: Manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance.

2.3 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 1. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Louvers: Factory install louvers in prepared openings.

2.4 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory that are indicated to receive transparent finish.
- C. Grade: Premium.
- D. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-4 conversion varnish or AWI System TR-6 catalyzed polyurethane.
- E. Staining: Match Architect's sample or As selected from manufacturer's full range.
- F. Sheen: Satin or Semigloss.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

3.2 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes access doors and frames for walls and ceilings.
 - 1. Provide access doors where shown on drawings or where required (in smallest size possible to suit intended purpose) to provide access to new or existing valves, junction boxes, dampers, etc... General Contractor shall coordinate types, sizes and locations of access doors with MEP/FP subcontractors.

1.4 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material in specified finish.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through 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.

1.6 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M.
 - 1. Provide electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M at wet or humid areas including but not limited to exterior, toilet rooms, locker/shower rooms, mechanical and boiler rooms, and janitor closets.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Factory-Primed Finish: Manufacturer's standard shop primer.
- D. Drywall Beads: 0.0299-inch zinc-coated steel sheet to receive joint compound.
- E. Manufacturer's standard finish.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babcock-Davis; A Ciera Products Co.
 - 2. J. L. Industries, Inc.
 - 3. Karp Associates, Inc.
 - 4. Larsen's Manufacturing Company.
 - 5. Milcor Inc.
- C. Flush Access Doors and Trimless Frames (AD-2): Fabricated from metallic-coated steel sheet.
 - 1. Locations: Interior wall and ceiling surfaces in areas exposed to view with painted drywall or plaster surfaces.
 - 2. Door: Minimum 0.060-inch thick sheet metal.
 - 3. Frame: Minimum 0.060-inch thick sheet metal with drywall bead or plaster bead as required at application.

4. Hinges: Spring-loaded, concealed-pin type.
5. Latch: Screwdriver-operated cam latch.
- 6.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view, provide materials with smooth, flat surfaces without blemishes.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder lock, furnish two keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083613 - SECTIONAL OVERHEAD DOORS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes electrically operated sectional overhead doors.
- B. See Division 5 Section "Metal Fabrications" for miscellaneous steel supports.
- C. See Division 13 Section "Metal Building Systems" for miscellaneous steel supports.
- D. See Division 16 Sections for electrical service and connections for powered operators and accessories.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Loads: Uniform pressure (velocity pressure) of 22 lbf/sq. ft., acting inward and outward.
- B. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

1.5 SUBMITTALS

- A. Product Data: For each type and size of sectional overhead door and accessory.
 - 1. Air infiltration data per ANSI/ASTM E 283.73
 - 2. Thermal Transmittance data per NAGDM 105-1986

- B. Shop Drawings: For special components and installations not detailed in manufacturer's product data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Doors with Insulated Steel Panels:
 - a. Clopay Building Products Company; a Griffon Company.
 - b. Haas Door; a Nofziger Company.
 - c. Overhead Door Corp.
 - d. Wayne-Dalton Corp.
 - e. Amarr Company

2.2 STEEL DOOR SECTIONS

- A. Construct door sections including face sheets and frames from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653, G60 coating designation.
 - 1. Steel Sheet Thickness: 0.022 inch (26 gage) minimum.
 - 2. Exterior-Section Face: Manufacturer's standard fine grooved.
- B. Fabricate door panels from a single sheet to provide sections not more than 24 inches high and nominally 2 inches deep.
- C. Enclose open sections with channel end stiles formed from not less than 0.064-inch- thick galvanized steel sheet installed over vinyl end caps to maintain the thermal break.
- D. Intermediate Reinforcing: To be nominal 18 gauge steel back-up plates, inserted prior to foaming, to provide proper position and reinforcing for attachment of various hardware.
- E. Reinforce bottom section with a continuous channel or angle complying with bottom-section profile and allowing installation of full length, vinyl astragal retainer.
- F. Provide a 4" or 5" exhaust port with latching spring lid in the bottom panel on the overhead doors as indicated on drawings. Confirm exhaust port size with owner.

- G. Provide reinforcement for hardware attachment.
- H. Thermal Insulation: Fully insulated section using high density CFC free polyurethane foam, pressure injected to completely fill the section, providing a composite structure. (Calculated R value = 17.5, U value = .10). Enclose insulation completely within steel sections that incorporate the following inside facing material, with no exposed insulation material evident:
 - 1. Inside Facing Material: Zinc-coated (galvanized) steel sheet, minimum 0.022 inch thick (26 gage).
- I. Thermal Break: Vinyl top and bottom caps on each section form the horizontal section joints, providing a complete thermal break.
- J. Header Seal: A top header vinyl seal is factory furnished for the top section.
- K. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.
- L. Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean galvanized surfaces so surfaces are free of oil and other contaminants.
 - a. Pretreat zinc-coated steel, after cleaning, with a conversion coating.
 - 2. Apply manufacturer's standard primer and finish coats to interior- and exterior-door faces after forming.

2.5 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's 3-inch, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Weld or bolt to track supports.
 - 1. Provide tracks configured for the following lift types:
 - a. Vertical.
 - b. High.
 - c.
 - 2. Track Reinforcement and Supports: Galvanized steel supporting members to provide strength and rigidity during opening and closing of doors.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of overhead door.
 - 1. Provide motor-operated doors with bottom weatherseal.
 - 2. Provide continuous flexible seals at door jambs for a weathertight installation.
- C. Windows: Type and size indicated and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel, as required.

1. Size: 24 inches by 6 inches (nominal), or nearest manufacturer standard size.
2. Manufacturer's standard insulated double strength glass unit.

2.6 HARDWARE

- A. General: Provide heavy-duty, corrosion-resistant hardware to suit door type.
- B. Hinges: Heavy-duty galvanized steel hinges at each end stile and at each intermediate stile. Attach hinges to door sections through stiles and rails. Provide double-end hinges where required and for doors exceeding 16 feet in width.
- C. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races.
 1. Tire Material: Case-hardened steel.
- D. Provide safety interlock switch to disengage power supply when door is locked.

2.7 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Fabricated from oil-tempered-steel wire, mounted on a solid cross-header steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Unless otherwise indicated, provide springs calibrated for a minimum of 10,000 cycles.
- B. Cable Drums: Cast-aluminum or gray-iron casting cable drums grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide 1 additional midpoint bracket for shafts up to 16 feet long and 2 additional brackets at one-third points to support shafts more than 16 feet long, unless closer spacing is recommended by door manufacturer.
- C. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either cable breaks.
- D. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level shaft and prevent sag.
- E. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.8 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, and accessories required for proper operation.
- B. Disconnect Device: Hand-operated disconnect device for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

- C. Provide control equipment, maximum 24-V, ac or dc.
- D. Door-Operator Type: Unit consisting of electric motor and the following:
 - 1. Gear-head hoist type, with enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor-level disconnect-release.
 - 1. Provide torque limiter as required by manufacturer.
- E. Electric Motors: High-starting torque, reversible, continuous-duty, with overload protection, sized to start, accelerate, and operate door in either direction from any position.
 - 1. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
- F. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop" in a NEMA 1 enclosure.
 - 1. For wet areas, like wash bays, utilize a NEMA 4 enclosure for the control station.
- G. Obstruction Detection Device: UL325 Compliant, unmodified, automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
- H. Limit Switches: Adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- I. Radio Control - Radio Control System:
 - 1. Each radio control capable of controlling both drive through doors in same bay. Separate button for each door. Coordinate operation with Owner.
- J. If any, provide additional door control devices as indicated on the electrical drawings and specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install door, track, miscellaneous framing, and operating equipment complete with necessary hardware according to Shop Drawings, manufacturer's written instructions, and as specified.

3.2 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup services.

3.3 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.
- B. Touch-up Painting: Immediately after welding galvanized track to track supports, clean field welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional overhead doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Exterior and interior aluminum-framed storefronts.
 - a. Glazing is retained mechanically with gaskets on four sides.
 - 2. Exterior and interior manual swing aluminum doors.
 - 3. Exterior and interior aluminum door frames.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 4. Dimensional tolerances of building frame and other adjacent construction.
 - 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.

- B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
 2. Seismic Loads: As indicated on Drawings.
- C. Deflection of Framing Members Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
- D. Structural-Test Performance: Systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity but not less than 10 seconds.
- E. Temperature Change (Range): Systems accommodate 120 deg F, ambient; 180 deg F, material surfaces.
- F. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of systems of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
- G. Water Penetration Under Static Pressure: Systems do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- H. Condensation Resistance: Fixed glazing and framing areas of systems have condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- I. Average Thermal Conductance: Fixed glazing and framing areas of systems have average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Samples: For each exposed finish.
- D. Product test reports.
1. Include NFRC certificates indicating total system U-value including framing and glazing.

- E. Field quality-control test and inspection reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Acceptable to manufacturer and capable of preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction schedule to avoid delaying the Work.

1.7 WARRANTY

- A. 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, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components to function properly.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. 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: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: The design for aluminum-framed systems is based on Kawneer Tri-Fab 451T.
- C. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. EFCO Corporation.
 - 2. United States Aluminum.

3. YKK AP America, Inc.
4. Vistawall Architectural Products.
5. Special-Lite, Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer.
 1. Structural Shapes, Plates, and Bars: ASTM A 36.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
 - 1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact.

2.5 DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual swing operation.
 - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-[thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 - 2. Door Design: Medium stile; 3-1/2-inch nominal width unless otherwise indicated on Drawings.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Beveled or Square, snap-on, extruded-aluminum stops and preformed gaskets.

2.6 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.
- B. Scheduled Door Hardware: Provide door hardware according to the Door Hardware Schedule.
 - 1. Named Manufacturer's Products: Product designation and hardware manufacturer are listed in the Door Hardware Schedule at the end of Part 3 to establish minimum requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware.
 - a. Named products are basis-of-design products. Provide named hardware manufacturer's products or submit comparable products that are equivalent in

function and quality and that are recommended and supplied by entrance system manufacturer for approval.

- C. Cylinders: As specified in Division 8 Section "Door Hardware."
- D. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

2.7 ACCESSORY MATERIALS

- A. Insulating Materials: As specified in Division 7 Section "Building Insulation."
- B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
- C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

- F. Doors: Reinforce doors as required for installing hardware.
 - 1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Color Anodic Finish: Class I, color anodic coating complying with AAMA 611.
 - 1. Color: Dark bronze

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Fit joints to produce hairline joints free of burrs and distortion.
 - 2. Rigidly secure nonmovement joints.
 - 3. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 4. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, without warp or rack.
- F. Install glazing as specified in Division 8 Section "Glazing."

- G. Entrances: Install to produce smooth operation and tight fit at contact points.
 - 1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
 - 2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
- I. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - 3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration. Can be performed by GC
- C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
4. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Aluminum-Framed Entrances and Storefronts"
5. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code

4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.

- 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- E. Inspection and Testing:
1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

- 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
2. Pre-installation Conference
 - a. Not more than 2 weeks prior to beginning door, frame and hardware installation, installing contractor shall meet with the door hardware manufacturer to review installation and adjustment procedures, as well as UL and NFPA compliance, for all major types (locks, closers and exit devices).
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Inspect and discuss preparatory work performed by other trades.
 - d. Inspect and discuss electrical roughing-in for electrified door hardware.
 - e. Review sequence of operation for each type of electrified door hardware.
 - f. Review required testing, inspecting, and certifying procedures.
 - g. Review questions or concerns related to proper installation and adjustment of door hardware.
 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Schlage ND Series: 10 years
 - 2) Exit Devices
 - a) Von Duprin: 10 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - b. Electrical Warranty
 - 1) Locks
 - a) Schlage: 3 years
 - 2) Exit Devices
 - a) Von Duprin: 3 years

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

- 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
- 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
- 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

- 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

- 1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
- 2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
- 3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
- 2. Acceptable Manufacturers and Products:
 - a. Hager BB1191/1279 series
 - b. McKinney TB series

B. Requirements:

- 1. Provide hinges conforming to ANSI/BHMA A156.1.
- 2. Provide five knuckle, ball bearing hinges.
- 3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

- a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Best
 - b. Roton

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin EPT-10
2. Acceptable Manufacturers and Products:
 - a. Securitron CEPT-10
 - b. Precision EPT-12C

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS**A. Manufacturers:**

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Rockwood
 - b. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS**A. Manufacturers:**

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 THREE POINT LOCK

A. Manufacturer and Product:

1. Scheduled Manufacturer and Product:
 - a. Sargent 7300
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin 6600 series

B. Requirements:

1. Provide three-point locking system as part of integrated assembly including door, frame, and hardware.
2. Tornado Applications: Provide assembly UL approved to FEMA 361 and FEMA 320 guidelines for inswing and outswing single or pair doors. Must be used with tested and approved door and frame system.
3. Security Applications: Provide inswing and outswing single or pair doors. Must be used with tested and approved door.
4. Units to comply with life safety requirements outlined in NFPA 80 and NFPA 101 and approved for use on up to 3-hour fire rated openings.
5. Latchbolt Construction:
 - a. Top Bolt: 5/8-inch (16 mm) Stainless Steel square bolt with 3/4-inch (19 mm) projection. 1/2 inch (13 mm) thick steel top plate. Stainless steel sill strike and fasteners.
 - b. Mortised Center Latchbolt: Stainless Steel latch. Fully wrapped, 12-gauge plated steel lock case. 2-3/4 inches (70 mm) backset. ANSI/BHMA curved lip strike 1-1/4 inches (32 mm) x 4-7/8 inches (124 mm) with dust box, non-handed.
 - c. Bottom Bolt: 5/8-inch (16 mm) Stainless Steel square bolt with 5/8-inch (16 mm) projection. Stainless steel sill strike and fasteners.
6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses or escutcheon as scheduled and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Provide levers that return to within 1/2 inch (13 mm) of door face.
 - b. Lever Design: ETL.

2.09 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series
 - b. Best 9K
2. Acceptable Manufacturers and Products:
 - a. Sargent 11-Line
 - b. Corbin-Russwin CL3100 series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
 - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.

- b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
 - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
- 3. Cylinders: Refer to "KEYING" article, herein.
 - 4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
 - 5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 - 6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 - 7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - 8. Provide electrified options as scheduled in the hardware sets.
 - 9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
 - b. Lever Design: RHO

2.10 EXIT DEVICES

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
 - a. Von Duprin 99/33A series
- 2. Acceptable Manufacturers and Products:
 - a. Precision APEX 2000 series
 - b. Sargent 19-43-GL-80 series

B. Requirements:

- 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
- 2. Cylinders: Refer to "KEYING" article, herein.
- 3. Provide grooved touchpad type exit devices, fabricated from brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match the balance of door hardware.
- 4. Touchpad must extend a minimum of one-half of the door width. No plastic inserts are allowed in touchpads.
- 5. Provide exit devices with a deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
- 6. Provide exit devices at pool gates with weather-resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
- 7. Provide flush end caps for exit devices.
- 8. Provide exit devices with manufacturers' approved strikes.
- 9. Provide exit devices cut to the door width and height. Install exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect.
- 10. Mount the mechanism case flush on the face of the doors or provide spacers to fill gaps behind the devices. Where glass trim or molding projects off the face of the door, provide glass bead kits.
- 11. Provide cylinder or hex-key dogging as specified at non-fire-rated openings.

12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide a type that can be removed by use of a keyed cylinder, which is self-locking when reinstalled.
13. Provide factory-drilled weep holes for exit devices used in full exterior applications, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors, eliminating the requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
 - a. Provide levers that return to within 1/2 inch (13 mm) of the door face.
17. Provide exit devices with PA filler.
18. Accessibility: Require not more than 5 lb. to retract the latchbolt, per CBC 2019 11B-404.2.7 and 11B-309.4.
 - a. Mechanical method: Von Duprin AX feature, where touchpad directly retracts the latchbolt with 5 lb. or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb. requirement.
 - b. Electrical method: Von Duprin's RX-QEL feature, where lightly pressing the touchpad with 5 lb. or less of force closes an electric switch, activating quiet electric latch retraction.

2.11 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series
2. Acceptable Manufacturers and Products:
 - a. Folger Adam 300 Series
 - b. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.12 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
2. Acceptable Manufacturers and Products:
 - a. Precision ELR series
 - b. Securitron BPS series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.13 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Match existing key system
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.14 KEYING

A. Scheduled System:

1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.

- 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.15 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Telkee
2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.16 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin DC8000 series
 - b. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.17 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.18 PROTECTION PLATES**A. Manufacturers:**

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.19 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS**A. Manufacturers:**

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.20 DOOR STOPS AND HOLDERS**A. Manufacturers:**

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.21 SILENCERS**A. Manufacturers:**

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Rockwood
 - b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.22 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING**A. Manufacturers:****B. Scheduled Manufacturer:**

1. Zero International

C. Acceptable Manufacturers:

1. National Guard
2. Pemko

D. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.

1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
 - a. Provide non-corrosive fasteners for all exterior applications.
 - b. Provide security fasteners where indicated.
2. Provide neoprene, EPDM, silicone, or nylon brush inserts as specified in hardware sets. Provide non brush inserts of solid or sponge cell, as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

E. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for smoke control ratings indicated based on testing according to UL 1784.**F. Fire Listed Gasketing:** Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction for fire ratings indicated based on testing according to UL-10C.

1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.
- G. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.
- H. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.
- I. Door Sweeps or Shoes: Apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.
 1. Provide solid neoprene, EPDM, silicone, or nylon brush type of seal as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.
- J. Automatic Door Bottoms:
 1. Provide closed cell sponge, bulb neoprene, or EPDM type of seal as specified in hardware sets.
 2. Door bottom to be mortised, semi mortised, or surface mount as with a minimum thickness as specified in hardware sets.
- K. Rain Drips:
 1. Provide overhead rain drips for out-swinging hollow metal doors that are not covered against 45 degree blowing rain. Aluminum extrusion to be a minimum of .088 inches thick and extend 2.50 inches from the face of the frame, in anodized finish to match door.
 2. Door sweeps or shoes with integral rain drip must meet ADA requirements
- L. Thresholds: Provide threshold units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, and fabricated to accommodate door hardware and fit door frames.
 1. Threshold extrusion to be a minimum thickness as specified in hardware sets.

2.23 DOOR POSITION SWITCHES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Schlage
 2. Acceptable Manufacturers:
 - a. GE-Interlogix
 - b. Sargent
- B. Requirements:
 1. Provide recessed or surface mounted type door position switches as specified.
 2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.24 FINISHES

- A. FINISH: BHMA 626/652 (US26D); EXCEPT:
 - 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 - 2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
 - 3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 - 4. Protection Plates: BHMA 630 (US32D)
 - 5. Overhead Stops and Holders: BHMA 630 (US32D)
 - 6. Door Closers: Powder Coat to Match
 - 7. Wall Stops: BHMA 630 (US32D)
 - 8. Latch Protectors: BHMA 630 (US32D)
 - 9. Weatherstripping: Clear Anodized Aluminum
 - 10. Thresholds: Mill Finish Aluminum
- B. FINISH: BHMA 643E/716 (US11); EXCEPT:
 - 1. Door Closers: Powder Coat to Match.
 - 2. Weatherstripping: Dark Bronze Anodized Aluminum.
 - 3. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds:
 - 1. Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
 - 2. Aluminum thresholds to be cut-in, and scribed around mullions, frame members, and stops. Do not butt to thresholds. Provide a continuous surface across full width of opening from jamb to jamb.
 - 3. Where aluminum panic-type (rabbeted) thresholds with neoprene inserts are specified, undercut doors as required to properly mate with seal in threshold.

- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing:
 - 1. Apply to head and jamb, forming seal between door and frame.
 - 2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

- 1) The hardware sets listed below represent design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process.

Legend:

 Link to catalog cut sheet

 Electrified Opening

Hardware Group No. 00.01

For use on Door #(s):

E103	E104A	E104B	E108C	E110	E112
E113	E114	E115	E116	E118B	E119
E121	E122				

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
EXISTING TO REMAIN				

Hardware Group No. 00.02

For use on Door #(s):

EO100	EO101	EO102	EO103	EO104	MO100
MO101	MO102	MO103	MO104	WO100	WO100
WO101					

Provide each RU door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
EA	NOTE	ALL HARDWARE BY OVERHEAD DOOR MANUFACTURER	UNF	BYO

Hardware Group No. 00.03

For use on Door #(s):

E108E

Provide each PR door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
EXISTING TO REMAIN				

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 00.04

For use on Door #(s):

E105 E108F E111

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC	 	630	VON

CONFIRM ELECTRIC STRIKE WILL WORK WITH EXISTING CONDITIONS.
BALANCE OF EXISTING HARDWARE TO REMAIN.

Hardware Group No. 00.05

For use on Door #(s):

E117

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC	 	630	VON

CONFIRM ELECTRIC STRIKE WILL WORK WITH EXISTING CONDITIONS.
BALANCE OF EXISTING HARDWARE TO REMAIN.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.01

For use on Door #(s):

116A 161A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		313AN	IVE
2	EA	POWER TRANSFER	EPT10 CON		⚡ 695	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9927-EO-CON 24 VDC		⚡ 710	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9927-NL-OP-110MD-CON 24 VDC		⚡ 710	VON
1	EA	RIM CYL HOUSING	AS REQ'D		643e	SCH
1	EA	FSIC CORE	PERMANENT CORE		643e	SCH
1	EA	FSIC CORE	KEYED CONST CORE		ORG	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 12" O		643E/716	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.			UNK
2	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
2	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
2	EA	WIRE HARNESS	CON-6W		⚡	SCH
2	EA	DOOR CONTACT	7764		⚡ 628	SCE
1	EA	POWER SUPPLY	PS904 900-2RS 120/240 VAC		⚡ LGR	SCE
2	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED			

CARD READER BY DIV 28

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

INACTIVE LEAF

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL WHEN LATCH RETRACTED ELECTRICALLY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.02

For use on Door #(s):

159 160 M100A M107

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		F643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON		✓ 695	VON
1	EA	EU STOREROOM LOCK	ND80JDEU RHO RX CON 12V/24V DC		✓ 643e	SCH
1	EA	FSIC CORE	PERMANENT CORE		643e	SCH
1	EA	FSIC CORE	KEYED CONST CORE		ORG	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		✓	SCH
1	EA	WIRE HARNESS	CON-6W		✓	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		✓ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS.
ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.03

For use on Door #(s):

146A H100

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		F643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 695	VON
1	EA	MULTIPOINT LOCK	73271 ETL RX 84"		⚡ 643e	SAR
1	EA	FSIC CORE	PERMANENT CORE		643e	SCH
1	EA	FSIC CORE	KEYED CONST CORE		ORG	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC MULTIPOINT LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS.

ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.04

For use on Door #(s):

157B-1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		F643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 695	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-QEL-99-NL-OP-F-110MD- CON 24 VDC		⚡ 710	VON
1	EA	RIM CYL HOUSING	AS REQ'D		643e	SCH
1	EA	FSIC CORE	PERMANENT CORE		643e	SCH
1	EA	FSIC CORE	KEYED CONST CORE		ORG	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O		643E/7 16	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

FIRE RATED OPENING**OPERATIONAL DESCRIPTION**

RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.05

For use on Door #(s):

M106

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80JDEU RHO RX CON 12V/24V DC		⚡ 626	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	FSIC CORE	KEYED CONST CORE		ORG	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MCSRI		689	LCN
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	GASKETING	328AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	65A		A	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS.

ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.06

For use on Door #(s):

W104A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		F643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 695	VON
1	EA	ELEC CYLINDRICAL LOCK	9KWDEU D		⚡ 643e	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS.

ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.07

For use on Door #(s):

E118C W100

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		F643E/ 716	IVE
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-OP-110MD- CON 24 VDC	 ⚡	710	VON
1	EA	RIM CYL HOUSING	AS REQ'D		643e	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O		643E/7 16	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D	 ⚡	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	 ⚡	LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 01.08

For use on Door #(s):

E108A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		F643E/ 716	IVE
2	EA	POWER TRANSFER	EPT10 CON		✓ 695	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9927-EO-CON 24 VDC		✓ 710	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9927-NL-OP-110MD- CON 24 VDC		✓ 710	VON
1	EA	RIM CYL HOUSING	AS REQ'D		643e	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
2	EA	90 DEG OFFSET PULL	8190EZHD 12" O		643E/7 16	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	EA	RAIN DRIP	142D		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	MEETING STILE	8193AA (2 PCS - 1 SET)		D	ZER
2	EA	DOOR SWEEP	39D		D	ZER
1	EA	THRESHOLD	65A		D	ZER
2	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		✓	SCH
2	EA	WIRE HARNESS	CON-6W		✓	SCH
2	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		✓ LGR	SCE
1			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.

SELF-CLOSING SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

INACTIVE LEAF

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL WHEN LATCH RETRACTED ELECTRICALLY. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 02.01

For use on Door #(s):

101 103B 148 M110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80JDEU RHO RX CON 12V/24V DC		⚡ 626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER SELF-CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 02.02

For use on Door #(s):

146B 147

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	MULTIPOINT LOCK	73271 ETL RX 84"		⚡ 626	SAR
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC MULTIPOINT LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER SELF-CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 02.03

For use on Door #(s):

133A 133B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	☐	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	☐	⚡ 689	VON
1	EA	PANIC HARDWARE	9927-EO-LBR	☐	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9927-L-LBR-06-CON 24 VDC	☐	⚡ 626	VON
1	EA	RIM CYL HOUSING	AS REQ'D	☐	626	SCH
1	EA	FSIC CORE	CONST/DISP CORE	☐	622	SCH
1	EA	FSIC CORE	PERMANENT CORE	☐	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH MC	☐	689	LCN
2	EA	SILENCER HM	SR64	☐	GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
2	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D	☐	⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	☐	⚡ LGR	SCE
1			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

SURFACE VOD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER. LATCHBOLT CAN BE RETRACTED ELECTRICALLY FOR EITHER MOMENTARY OR EXTENDED PERIODS OF TIME ALLOWING DOOR TO BE PUSH/PULL FUNCTION. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL RETRACT LATCHBOLT ELECTRICALLY ALLOWING DOOR TO BE OPENED.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

INACTIVE LEAF

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. EXIT ONLY, NO EXTERIOR TRIM.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 02.04

For use on Door #(s):

W108

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC CYLINDRICAL LOCK	9KWDEU D		⚡ 626	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		⚡ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER SELF-CLOSING.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 02.05

For use on Door #(s):

E101A E101B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		✂ 689	VON
2	EA	MANUAL FLUSH BOLT HM	FB457		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	ELEC CYLINDRICAL LOCK	9KWDEU D		✂ 626	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
2	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	SILENCER HM	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ'D		✂	SCH
1	EA	WIRE HARNESS	CON-6W		✂	SCH
2	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D		✂ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-8P 120/240 VAC		✂ LGR	SCE
			CARD READER BY DIV 28			

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

ELEC STOREROOM LOCK - OUTSIDE LEVER LOCKED. FAIL SECURE. UNLOCKED BY KEY OUTSIDE OR ELECTRICALLY. INSIDE LEVER ALWAYS FREE FOR EGRESS. ACCESS CONTROL SOFTWARE OR PRESENTING AUTHORIZED CREDENTIAL SHALL UNLOCK DOOR ALLOWING DOOR TO BE OPENED. RX SWITCH MONITORS OPERATION OF THE INTERIOR LEVER SELF-CLOSING.

INACTIVE LEAF

MANUAL FLUSH BOLTS

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED

.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 03.01

For use on Door #(s):

100A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY	☐	710	IVE
1	EA	PANIC HARDWARE	CD-9927-EO	☐	710	VON
1	EA	PANIC HARDWARE	CD-9927-NL-OP-110MD	☐	710	VON
2	EA	MORT CYL HOUSING	AS REQ'D		643e	SCH
1	EA	RIM CYL HOUSING	AS REQ'D	☐	643e	SCH
3	EA	FSIC CORE	PERMANENT CORE	☐	643e	SCH
3	EA	FSIC CORE	KEYED CONST CORE	☐	ORG	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 12" O	☐	643E/7	IVE
					16	
2	EA	SURFACE CLOSER	4040XP SCUSH MC	☐	695	LCN
1	EA	RAIN DRIP	142D	☐	D	ZER
2	EA	DOOR SWEEP	39D	☐	D	ZER
1	EA	THRESHOLD	65A	☐	D	ZER
2	EA	DOOR CONTACT	7764	☐	✓ 628	SCE
2	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED			
1	EA		BALANCE OF GASKETING BY DOOR/FRAME MFR.			

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY.

DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL.

SELF-CLOSING SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

INACTIVE LEAF

SURFACE ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL WHEN DEVICE DOGGED DOWN.

DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 04.01

For use on Door #(s):

100B 116B 161B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		313AN	IVE
2	EA	DUMMY PUSH BAR	330		710	VON
2	EA	90 DEG OFFSET PULL	8190EZHD 12" O		643E/7 16	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC		695	LCN
1	SET	WEATHER STRIPPING	BY DOOR/FRAME MFR.			UNK
2	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED			

OPERATIONAL DESCRIPTION

DUMMY EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL. NON-LOCKING, NON-LATCHING.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 04.02

For use on Door #(s):

122 123 154D 155 E110B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

OPERATIONAL DESCRIPTION

FREE EGRESS AND ENTRY AT ALL TIMES BY PUSH PLATE OR PULL. NON-LOCKING, NON-LATCHING.

SELF CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 04.03

For use on Door #(s):

W105

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
2	EA	PUSH PLATE	8200 4" X 16"		630	IVE
2	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
2	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

FREE EGRESS AT ALL TIMES BY PUSH PLATE. ENTRY BY PULL. NON-LOCKING, NON-LATCHING. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 04.04

For use on Door #(s):

103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED			
1	EA		BALANCE OF GASKETING BY DOOR/FRAME MFR.			

OPERATIONAL DESCRIPTION

FREE EGRESS AND ENTRY AT ALL TIMES BY PUSH PLATE OR PULL. NON-LOCKING, NON-LATCHING. SELF CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 05.01

For use on Door #(s):

117B 118B 120A M101

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

PASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.

Hardware Group No. 05.02

For use on Door #(s):

108 127 143

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

PASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.

Hardware Group No. 05.03

For use on Door #(s):

115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTIONPASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.
SELF CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 05.04

For use on Door #(s):

114 145 150B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	BALANCE OF GASKETING BY DOOR/FRAME MFR.				

OPERATIONAL DESCRIPTION

PASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.

Hardware Group No. 05.05

For use on Door #(s):

157C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	99-L-BE-06		626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY TURNING LEVER. LEVER ALWAYS FREE FOR ENTRY. SELF CLOSING.

Hardware Group No. 05.06

For use on Door #(s):

E106B E108D

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CYLINDRICAL LOCKS	9KN D		626	BES
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

PASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 05.07

For use on Door #(s):

E118A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CYLINDRICAL LOCKS	9KN D		626	BES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

PASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.

Hardware Group No. 06.01

For use on Door #(s):

102 119 153 M104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

OPERATIONAL DESCRIPTION

PRIVACY LOCK - PUSH-BUTTON LOCKING. WHEN LOCKED, CAN BE OPENED FROM OUTSIDE WITH SMALL SCREWDRIVER. TURNING INSIDE LEVER OR CLOSING DOOR RELEASES BUTTON. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 06.02

For use on Door #(s):

E109

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

OPERATIONAL DESCRIPTION

PRIVACY LOCK - PUSH-BUTTON LOCKING. WHEN LOCKED, CAN BE OPENED FROM OUTSIDE WITH SMALL SCREWDRIVER. TURNING INSIDE LEVER OR CLOSING DOOR RELEASES BUTTON. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

VISUAL INDICATOR DISPLAYS OCCUPIED/VACANT ON OUTSIDE FACE OF DOOR.
SELF CLOSING.

Hardware Group No. 07.01

For use on Door #(s):

E100 E102A E103B W101 W102 W104B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CYLINDRICAL LOCKS	9KAB D		626	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

OFFICE LOCK - TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSHBUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 07.02

For use on Door #(s):

107	109	110	111	112	117
118	120B	128	129	130	131
132	135	136	137	138	139
140	141	142	M103		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND53JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

OFFICE LOCK - TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSHBUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 08.01

For use on Door #(s):

151

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	ND70JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

CLASSROOM LOCK - OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 08.02

For use on Door #(s):

126

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
2	EA	MANUAL FLUSH BOLT HM	FB457		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	CLASSROOM LOCK	ND70JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	OH STOP & HOLDER	90H		630	GLY
1	EA	SURFACE CLOSER	4040XP SHCUSH MC		689	LCN
2	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

CLASSROOM LOCK - OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.
SELF CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED. HOLD OPEN OPTION.

INACTIVE LEAF

MANUAL FLUSH BOLTS.

SURFACE MOUNTED OVERHEAD STOP /HOLD OPEN

Hardware Group No. 08.03

For use on Door #(s):

157A

157B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-06		626	VON
1	EA	RIM CYL HOUSING	AS REQ'D		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

OPERATIONAL DESCRIPTION**FIRE RATED OPENING**

RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER
SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 08.04

For use on Door #(s):

150A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	ND70JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

CLASSROOM LOCK - OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

Hardware Group No. 08.05

For use on Door #(s):

M100B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		630	IVE
1	EA	CLASSROOM LOCK	ND70JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MCSRI		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

CLASSROOM LOCK - OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 08.06

For use on Door #(s):

E107

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CYLINDRICAL LOCKS	9KR D		626	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

CLASSROOM LOCK - OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

Hardware Group No. 09.01

For use on Door #(s):

121 149 M102 M105

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF-CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 09.02

For use on Door #(s):

113

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

FIRE RATED OPENING**OPERATIONAL DESCRIPTION**

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

Hardware Group No. 09.03

For use on Door #(s):

124

125

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF-CLOSING.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 09.04

For use on Door #(s):

158

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	ND80JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB		689	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	GASKETING	488SBK PSA		BK	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

ACTIVE LEAF

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

SELF-CLOSING. SPRING LOADED STOP. PUSH SIDE MOUNTED.

INACTIVE LEAF

CONSTANT LATCHING FLUSH BOLTS. INACTIVE DOOR LATCHES AUTOMATICALLY WHEN CLOSED. SELF-CLOSING. SPRING LOADED STOP. PUSH SIDE MOUNTED.

COORDINATOR ALLOWS INACTIVE LEAF TO CLOSE BEFORE ACTIVE LEAF.

Hardware Group No. 09.05

For use on Door #(s):

144

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80JD RHO		626	SCH
1	EA	FSIC CORE	CONST/DISP CORE		622	SCH
1	EA	FSIC CORE	PERMANENT CORE		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

DOOR HARDWARE

25012.00 / TCRECC

Hardware Group No. 09.06

For use on Door #(s):

E124 W103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CYLINDRICAL LOCKS	9KD D		626	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	SURFACE CLOSER	4040XP RW/PA MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF-CLOSING.

Hardware Group No. 09.07

For use on Door #(s):

W106

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
2	EA	MANUAL FLUSH BOLT HM	FB457		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	CYLINDRICAL LOCKS	9KD D		626	BES
1	EA	SFIC CORE	SFIC PERMANENT CORE		622	BES
1	EA	SURFACE CLOSER	4040XP HW/PA MC		689	LCN
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	SILENCER HM	SR64		GRY	IVE

OPERATIONAL DESCRIPTION**ACTIVE LEAF**

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING. HOLD OPEN INCLUDED.

INACTIVE LEAF

MANUAL FLUSH BOLTS.

END OF SECTION

SECTION 088000 - GLAZING**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Glazed entrances.
 - 4. Storefront framing.

1.4 DEFINITIONS

- A. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- B. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- C. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable

to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Design: 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. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As indicated on Structural Drawings, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."
 - b. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: As indicated on Structural Drawings
 - 2) Importance Factor: As indicated on Structural Drawings
 - 3) Exposure Category: As indicated on Structural Drawings
 - c. Specified Design Snow Loads: As indicated on Structural Drawings, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."
 - d. 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.
 - 1) Load Duration: 3 seconds.
 - e. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.
 - 1) Load Duration: 30 days.
 - f. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 - g. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
 - C. 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. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 - D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite 6.0 mm thick and a nominal 1/2-inch- wide interspace.
3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: 12-inch- square, for each type of glass product indicated, other than monolithic clear float glass.
- C. Glazing Schedule: Use same designations indicated on Drawings.
- D. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer.

1.7 QUALITY ASSURANCE

- A. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing according to ASTM C 1087, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
- B. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council or Associated Laboratories, Inc.
- E. 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 mockups Provide one (1) mockup as indicated on the drawings.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide product specified or approved equal by one of the following:
- a. Viracon
 - b. Guardian
 - c. Old Castle Glass
 - d. Vitro Architectural Glass (previously PPG Industries, Inc.)
 - e. Pilkington Building Products
 - f. AFG Industries, Inc.

2.2 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.
- a. Products:
- 1) AFG Industries Inc.; Krystal Klear.
 - 2) Pilkington Building Products North America; Optiwhite.
 - 3) Vitro Architectural Glass; Starphire.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 3. For uncoated glass, comply with requirements for Condition A.
 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
- C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one surface ceramic coated), Type I (transparent flat glass), Quality-Q3, and complying with other requirements specified.
1. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
 2. Factory apply manufacturer's standard ceramic opacifier to indicated coated surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA Tempering Division's "Engineering Standards Manual."
- D. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 3. Sealing System: Dual seal.
 4. Spacer Specifications: Manufacturer's standard spacer material and construction.
 5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material: Aluminum with mill or clear anodic finish
 - b. Corner Construction: Manufacturer's standard corner construction.

2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
1. Neoprene, ASTM C 864.
 2. EPDM, ASTM C 864.
 3. Silicone, ASTM C 1115.
 4. Thermoplastic polyolefin rubber, ASTM C 1115.

5. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. Neoprene.
 2. EPDM.
 3. Silicone.
 4. Thermoplastic polyolefin rubber.
 5. Any material indicated above.

2.4 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.8 MONOLITHIC FLOAT-GLASS UNITS

- A. Uncoated Clear Float-Glass Units MG-1: For use in interior borrowed lites, door vision panels, and other applications where ¼" clear glazing is indicated.
 - 1. Class 1 (clear) annealed or Kind HS (heat-strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements. Provide Kind FT (fully tempered) float glass where safety glass is indicated.
 - a. Thickness: 6.0 mm

2.9 INSULATING-GLASS UNITS

- A. Tinted Insulating-Glass Units IG-1: For use in storefront assemblies, windows, and other applications where 1" insulated glazing is indicated.
 - 1. Products:
 - a. Solarban 60 (2) Solargray + Clear by Vitro Architectural Glass.
 - 2. Insulating Unit Construction: ¼ inch (6mm) tinted Float Glass, Solarban 60 Solar Control (sputtered) on second surface (2) outdoor lite, + ½ inch (13mm) interspace + ¼ inch (6mm) Clear Float Glass indoor lite.
 - 3. Interspace Content: Air with aluminum mill finish spacer and black silicone.
 - 4. Outdoor Lite: Class 2 (tinted) float glass.
 - a. Tint Color: Solargray.
 - b. Annealed, Kind HS (heat strengthened) or Kind FT (fully tempered) as required by application and/or locations.
 - c. ASTM 1036 Type 1, Class 2 (tinted, heat absorbing and light reducing), quality Q3

- d. ASTM C 1048 Condition C, Kind HS, unless noted otherwise.
 5. Indoor Lite: Class 1 (clear) float glass.
 - a. Annealed, Kind HS (heat strengthened) or Kind FT (fully tempered) as required by application and/or locations.
 - b. ASTM 1036 Type 1, Class 1 (Clear), Quality Q3
 - c. ASTM C 1048 Condition A, Kind HS, unless noted otherwise
 6. Visible Light Transmittance: 35 percent minimum.
 7. Winter Nighttime U-Factor: 0.29 maximum.
 8. Solar Heat Gain Coefficient: 0.25 percent maximum.
 9. Outdoor Visible Light Reflectance: 6 percent
- B. Tinted Insulating-Glass Units IG-2 (spandrel panels): For use in storefront assemblies, windows, and other applications where 1" insulated glazing is indicated.
1. Products:
 - a. Solarban 60 (2) Solargray + Clear by Vitro Architectural Glass.
 2. Insulating Unit Construction: ¼ inch (6mm) tinted Float Glass, Solarban 60 Solar Control (sputtered) on second surface (2) outdoor lite, + ½ inch (13mm) interspace + ¼ inch (6mm) Clear Float Glass indoor lite with ceramic coating or silicone opacifier on #4 surface
 3. Interspace Content: Air with aluminum mill finish spacer and black silicone.
 4. Outdoor Lite: Class 2 (tinted) float glass.
 - a. Tint Color: Solargray.
 - b. Annealed, Kind HS (heat strengthened) or Kind FT (fully tempered) as required by application and/or locations.
 - c. ASTM 1036 Type 1, Class 2 (tinted, heat absorbing and light reducing), quality Q3
 - d. ASTM C 1048 Condition C, Kind HS, unless noted otherwise.
 5. Indoor Lite: Class 1 (clear) float glass with ceramic coating or silicone opacifier on #4 surface
 - a. Annealed, Kind HS (heat strengthened) or Kind FT (fully tempered) as required by application and/or locations.
 - b. ASTM 1036 Type 1, Class 1 (Clear), Quality Q3
 - c. ASTM C 1048 Condition A, Kind HS, unless noted otherwise
 6. Visible Light Transmittance: 2 percent minimum.
 7. Winter Nighttime U-Factor: 0.47 maximum.
 8. Solar Heat Gain Coefficient: 0.34 percent maximum.
 9. Outdoor Visible Light Reflectance: 8 percent

PART 3 - EXECUTION

3.1 GLAZING

- A. General: Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
1. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
 2. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
 3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
 4. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
 5. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
 6. Provide spacers for glass lites where length plus width is larger than 50 inches
 7. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- B. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
1. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
 2. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 3. Apply heel bead of elastomeric sealant.
 4. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 5. Apply cap bead of elastomeric sealant over exposed edge of tape.
- C. Gasket Glazing (Dry): Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 2. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3. Install gaskets so they protrude past face of glazing stops.

D. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.2 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 088801 – BULLET RESISTANT GLAZING**PART 1 - GENERAL****1.1 REFERENCE**

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment & ASTM E119-98-Standard Test Methods for Fire Tests of Building Construction and Materials, NIJ Standard 0108.01-(National Institute of Justice) Standard for Ballistic Resistant Protective Materials, ASTM B 209/B 209M- Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate, ASTM A 666-Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar..

1.2 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.3 SUMMARY

- A. This Section includes bullet resistant items for the Office Building Lobby as follows:
 - 1. Bullet resistant glazing
 - 2. Bullet resistant accessories
- B. Related Sections include the following:
 - 1. Division 6 Section “Bullet Resistant Composite Panels”
 - 2. Division 6 Section “Interior Architectural Woodwork”
 - 3. Division 7 Section "Joint Sealants"
 - 4. Division 9 Section "Gypsum Board Assemblies"

1.4 SUBMITTALS

- A. The following shall be submitted by the manufacturer in accordance with Sections 13070 and any Special Contract Requirements and coordinate with Sections 01340: Submit for approval prior to fabrication: samples, product data (including preparation, storage and installation methods), cuts & anchor spacing, reinforcement & location , product specifications, shop drawings, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents.
- B. Manufacturer’s Instructions for installation and cleaning of TSS Bullet Resistant Assemblies. All required submittals shall be approved prior to installation.

1.5 DESIGN PERFORMANCE

- A. Through the design, manufacturing techniques and material application the TSS Bullet Baffle Design Bandit Barrier. This assembly shall provide multiple transaction positions utilizing the "Baffle Window" configuration. This design shall employ Baffle windows in teller line ballistic glazing to complete the "Baffle" design. Each transaction position shall have a stainless steel dip tray as shown on the drawings. Components must be manufactured in strict accordance with the specifications, design and details. All vision panels shall be cut to size with all exposed edges polished. Necessary holes shall be pre drilled and tapped where required. Stainless Steel assembly screws and acrylic spacers shall be provided. Clear anodized angles, channels and anchoring screws shall be provided.
- B. No field alterations to the construction of the assembly fabricated under the acceptable standards shall be allowed unless approved by the manufacturer and the architect. Standard manufacturing tolerances shall be +/- 1/16".
- C. Materials shall meet or exceed UL 752 requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of five years experience. Installer shall be a Company that specializes in product type specified and Certified for the installation by the manufacturer. Manufacturer shall provide a sampling, if required, for evaluation of surface preparation and application workmanship and color/finish to the Architect for approval prior to start of work.

1.7 DELIVERY, STORAGE & HANDLING

- A. Delivery of the materials to the project with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.8 WARRANTY

- A. All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. Certificates of manufacturer's standard limited warranty shall be provided at project completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Basis of Design is Total Security Solutions as listed below.

1. Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, 866-930-7807. Jim Richards, info@demandtss.com . Web: www.tssbulletproof.com .

2.2 BULLET RESISTANT BAFFLE SYSTEM

- A. Basis of Design: TSS Baffle Bandit Barrier: The Baffle System consists of custom prefabricated bullet resistant wall section panels with secure air passage through the baffle window transaction point as required for voice transmission. Aluminum channel, acrylic mounting clips, acrylic buttresses and accessories for installation are included. Available finishes include clear anodized or powder coated.
- B. Glazing shall be Bullet Resistant Level 3 as shown on the drawings. All acrylic pieces shall meet or exceed UL 752 testing for ballistic integrity. All edges of acrylic shall be filed, sanded after cutting to remove rough edges and then polished until "water clear" transparent. All through holes for fasteners shall be 3/8" in diameter and be drilled clean. Chipped edges at through-hole exit points are not acceptable. All acrylic pieces shall be supported in the proper glazing channel designed for this purpose (see aluminum, Section D).
 - a. Bullet Resistant Level 3; 1 1/4" LP 1250 Laminated
- C. Deal Trays: Basis of Design TSS Recessed Cash Tray with bullet trap, 16 inches by 10 inches from the outside edge of flanges with a clear open depth under the glazing no less than 1-1/2 inch. Fabricate of a minimum 18 gauge stainless steel 304, with a No. 4 finish. Cash tray: Recessed Brushed Stainless Steel
- D. Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Black Anodized or powder coated finish and be free of sharp edges or burrs when in place. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment. All exposed aluminum edges shall be clean cut and have no burrs. Exposed corners shall be rounded and sanded.
- E. Mounting plates and or connecting clips shall be fabricated from 1/8" thick clear polycarbonate.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installing the bullet resistive material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop/CAD drawings, if required. Installer shall notify architect of any unsatisfactory preparation that is responsibility of another installer.
- B. Clean and prepare all surfaces per manufacturers recommendations for achieving the best results for the substrate under the project conditions.

3.2 INSTALLATION

- A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Install in accordance with manufacturer's instructions and UL 752.

Set all equipment plumb. All products shall be installed per installation instructions provided by Total Security Solutions, if warranty is to be issued.

- B. Bullet resistant baffle system shall arrive on site completely pre-fabricated to supplied field dimensions. Unit shall be installed in provided opening and secured to structure.

3.3 POST APPLICATION

- A. Bullet resistant baffle system shall be installed in accordance with manufacturer's printed recommendations, including adhering to anchoring and finishing details.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements. Clean product and accessories, removing excess sealant, labels and protective covers.
- C. Touch-up, repair or replace damaged products before Substantial Completion.
- D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

END OF SECTION 088800

SECTION 092900 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Chase enclosures.
 - 4. Non-load-bearing steel framing
- B. See Division 7 Section “Joint Sealants” for application of acoustical joint sealants.

1.4 SUBMITTALS

- A. Product Data: For each type of product and gypsum board assembly indicated.
 - 1. Steel Studs:
 - a. Submit letter indicating that the studs comply with the most recent edition of ASTM C645
 - b. Submit 3rd party evaluation report in accordance with ICC-ES-AC86-2010.
 - c. Submit Kminimum metal thickness (gage) to be provided for each size vertical stud framing member to limit deflection to L/240 for each span indicated at 5 psf horizontal load in accordance with manufacturer’s published design data.
 - d. Submit stud manufacturer’s recommendations for bracing stud partitions.
- B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 and displaying a classification label from an independent testing and inspecting agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.6 DELIVERY STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.
- C. Steel framing and accessories shall be stored and handled in accordance with AISI's "Code of Standard Practice"

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 STEEL FRAMING

- A. Steel Framing, General: Comply with ASTM C 754 for conditions indicated.
 1. Steel Sheet Components: Metal complying with ASTM C 645 requirements.
 - a. Protective Coating:
 - 1) Interior Applications: ASTM A1003/A 1003M and ASTM A 653/A 653M, G40 (Z120), roll formed from hot-dip galvanized zinc coating, or having a coating that provides equivalent corrosion resistance. A40 galvanized products are not acceptable.
 - 1) Exterior Applications: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

- 1) ClarkDietrich Building Systems, ProSTUD Drywall Studs.
- 2) Telling Industries, ViperStud Drywall Framing System

B. Suspended Ceiling and Soffit Framing:

1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.
2. Hanger Attachments to Concrete:
 - a. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
 - 1) Type: Cast-in-place anchor, designed for attachment to concrete forms, Postinstalled, chemical anchor, or Postinstalled, expansion anchor.
 - b. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
4. Carrying Channels: ASTM C745 cold-formed from commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch wide flange, and in depth indicated.
5. Furring Channels (Furring Members):
 - a. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange, 3/4 inch deep.
 - b. Steel Studs: ASTM C 645, in depth indicated
 - c. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - 1) Minimum Base Metal Thickness: 0.0179 inch
 - d. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission, and asymmetrical with single leg or hat shaped with two legs.

C. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products:
 - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - b. Chicago Metallic Corporation; Fire Front 630 System.
 - c. USG Interiors, Inc.; Drywall Suspension System.

D. Partition and Soffit Framing:

1. Steel Studs and Runners: ASTM C 645, in depth indicated, as described above.
 - a. Minimum Base Metal Thickness: As required by performance requirements for horizontal deflection, but in no case less than 0.0150 inch.
 - 1) Provide minimum of 20 ga equivalent drywall studs at partitions to receive cement backer board and/or ceramic tile.
 - b. Non-structural Studs: Cold-formed galvanized steel C-studs, ClarkDetrich ProSTUD® drywall studs or approved equal, in conformance with ASTM C-754 for conditions indicated below:
 - 1) Flange Length: 1 1/4 inch (32mm) 125 flange.
 - 2) Web Depth: As indicated on drawings.
 - 3) Minimum Designation: 25ga equivalent drywall stud (unless noted otherwise). 70ksi
Minimum Thickness: As required by performance requirements for horizontal deflection, but in no case less than 0.0150 inches (0.3810mm)
Minimum Design Thickness: 0.0158 inches (0.4013mm)
 - 4) "EQ" (Equivalent Gauge Thickness) Steel Studs and Runners: Members that can show certified third party testing in accordance with ICC-Evaluation Service and conform to the limiting height tables in Specification C 754 need not meet the minimum thickness limitation or the minimum section properties set forth in ASTM C645-09.
 - c. Non-structural Track: Cold-Formed galvanized steel runner tracks, ClarkDetrich ProTRAK™ drywall track or approved equal, in conformance with ASTM C-645-09 for conditions indicated below:
 - 1) Flange Length: 1 1/4 inch (32 mm) T125 flange.
 - 2) Web Depth: Track web to match stud web size.
 - 3) Minimum Material Thickness: Track thickness to match wall stud thickness.
2. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch deep flanges.
3. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.
 - a. Products:
 - 1) ClarkDetrich; MaxTrak
 - 2) Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
 - 3) Metal-Lite, Inc.; Slotted Track.
4. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products:
 - 1) ClarkDetrich; MaxTrak

- 2) Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - 3) Metal-Lite, Inc.; The System.
5. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - a. Minimum Base Metal Thickness: As indicated
6. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange, and in depth indicated.
 - a. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch thick, galvanized steel.
7. Hat-Shaped, Rigid Furring Channels: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness: 0.0179 inch.
8. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission. Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
9. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch wide flange, and in depth indicated.
 - a. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
 - b. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.
- E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 1396/C 1396M-09a, as applicable to type of gypsum board indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. Temple Inland.
 - e. USG Corporation.
- B. Regular Type:
 1. Thickness: 5/8".
 2. Long Edges: Tapered.
 3. Location: As indicated.

C. Type X:

1. Thickness: 5/8".
2. Long Edges: Tapered.
3. Location: As indicated.

D. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.

2.3 TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. G-P Gypsum.
 - b. National Gypsum Company.
 - c. Temple Inland.
 - d. USG Corporation.
2. Core: 5/8 inch, Type X or Special Type X as required by fire-resistance-rated assembly indicated on Drawings.

B. Cementitious Backer Units: ANSI A108.1.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Wonderboard.
 - b. USG Corporation; DUROCK Cement Board.
3. Thickness: As indicated on Drawings or 1/2 inch minimum.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.

- c. LC-Bead: J-shaped; exposed long flange receives joint compound.
- d. L-Bead: L-shaped; exposed long flange receives joint compound.
- e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- f. Expansion (control) joint.
- g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

- 1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
- 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

- 1. Interior Gypsum Wallboard: Paper.
- 2. Exterior Gypsum Soffit Board: Paper.
- 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- 4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
- 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
- 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
- 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound [high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish].

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."
- F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."
- G. Vapor Retarder: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 NON-LOAD-BEARING STEEL FRAMING INSTALLATION

- A. General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Suspended Ceiling and Soffit Framing:

1. Suspend ceiling 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. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers 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.
3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
4. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
5. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

C. Partition and Soffit Framing:

1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.
2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board. Brace all partition framing as recommended by stud manufacturer.
3. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
4. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D.

3.2 PANEL PRODUCT INSTALLATION

A. Gypsum Board: Comply with ASTM C 840 and GA-216.

1. Space screws a maximum of 12 inches o.c. for vertical applications.
2. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
3. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

4. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
5. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
6. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.
7. Laminating to Substrate: Comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

B. Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Install with 1/4-inch gap where panels abut other construction or penetrations.
2. Cementitious Backer Unit Application: ANSI A108.11.

3.3 FINISHING

- A. Installing Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Finishing Gypsum Board Panels: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
 1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 3. Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.
- C. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, 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 separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile or acoustical tile and where indicated .
 3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at all exposed walls, soffits and ceilings.
 4. 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 at surfaces subject to severe lighting. It is considered a high-quality gypsum board finish.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - CERAMIC TILE**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Tile Products
 - 2. Waterproof & Crack isolation membrane.
 - 3. Tile backing panels.
 - 4. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints.
- C. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Assembled samples, with grouted joints, for each type and composition of tile and for each color and finish required.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all tile from one source or producer.
 - 1. Obtain tile 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 a single 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 through one source from a single manufacturer for each product:
1. Grouts
 2. Waterproofing
 3. Joint Sealants
 4. Metal Edge Strips

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

- A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. Tile Types: As indicated on Drawings.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
 2. Grout Color: Product indicated on Drawings or selected by Architect from manufacturer's full range.
 3. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide product indicated on Drawings, or to be selected selected from manufacturer's standard shapes.
- C. Floor tiles shall have a Dynamic Coefficient of Friction (DCOF) of ≥ 0.42 , when tested in accordance with ANSI A137.1
1. Provide tile manufacturer's verification that specified product meets this requirement.

2.2 TILE BACKING PANELS

- A. Refer to Division 9 Section "Gypsum Board Assemblies"

2.3 WATERPROOF & CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Boiardi Products, a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.

- b. Bonsal American, an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
- c. Bostik, Inc.; Hydroment Blacktop 90210.
- d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
- e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
- f. MAPEI Corporation; Mapelastic L (PRP M19).
- g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
- h. Summitville Tiles, Inc.; S-9000.

C. Alternate materials and products will be considered upon request of installer.

2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or approved equal.
 - 2. Prepackaged, dry-mortar mix to which only water must be added.
 - 3. Prepackaged, dry-mortar mix combined with liquid-latex additive.
 - 4. For wall applications, provide nonsagging mortar.
 - 5. Manufacturers: Subject to compliance with requirements, provide product indicated or approved equal by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
 - d. TEC; a subsidiary of H. B. Fuller Company.

2.5 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10.
 - 1. Manufacturers: Subject to compliance with requirements, provide product indicated or approved equal by one of the following, Basis of design – Laticrete 1500 Sanded Grout:
 - a. Bonsal American; an Oldcastle company.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
 - d. TEC – AccuColor Grouts; a subsidiary of H. B. Fuller Company.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the applicable requirements in Section 079200 "Joint Sealants."

2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, exposed-edge material.
 - 1. Manufacture: Schluter with finish and profile as indicated on finish drawings.
- C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. 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 toward drains.
- C. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series

"Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors composed of tiles 8 by 8 inches or larger.
 - c. Tile floors composed of rib-backed tiles.
- B. 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.
- C. 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.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. 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. Tile joint laps shall not be greater than 33% of total width of tile to avoid emphasis of warpage characteristics of the tile
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Ceramic Mosaic Tile: 1/16 inch
 2. Glazed Wall Tile: 1/16 inch
 3. Decorative Thin Wall Tile: 1/16 inch
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. 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."
- I. Metal Edge Strips: Install at locations indicated, or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile, where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

- J. 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.
- K. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- L. 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.
- M. 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.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed finish.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics:
 - 1. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
- B. Seismic Standard: Comply with the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with basic minimums established in ASTM C636
 - 2. ASCE 7
 - 3. CISCA's (Ceilings and Interior Systems Construction Association) Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-1."

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels 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

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641, Class 1 zinc coating, soft temper.
 1. Size: Select wire diameter so its stress at 3 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-diameter wire, 12 ga.
 2. Hanger wires spaced 4' on center, max. along main beams
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Products: Subject to compliance with requirements, provide the products indicated on drawings or comparable products from one of the manufacturers listed below and approved by the architect.
 1. Armstrong World Industries, Inc.
 2. Chicago Metallic Corporation.
 3. USG Interiors, Inc.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Products: Subject to compliance with requirements, provide products from one of the following:
 1. Armstrong World Industries, Inc.
 2. Chicago Metallic Corporation.
 3. USG Interiors, Inc.
- B. Double-Web, Fire-Rated, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according

to ASTM A 653, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges. Galvanized in exterior or wet locations.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Cap Material: Steel cold-rolled sheet.
4. Cap Finish: Painted white, unless otherwise indicated.
5. Comply with Seismic Design Requirements

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. 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.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. 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. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 2. Do not attach hangers to steel deck tabs or to steel roof deck.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION 095113

SECTION 096500 - RESILIENT FLOOR TILE AND ACCESSORIES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:

- 1. Luxury vinyl tile (LVT)
- 2. Wall base.
- 3. Molding accessories.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: Of each color and pattern of resilient product required.

1.5 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during and for 48 hours after floor covering installation.
- D. Install resilient products after other finishing operations, including painting, have been completed.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
 - 2. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS**2.1 LUXURY VINYL TILE (LVT)**

- A. Solid Vinyl Floor Tile: ASTM F 1700.
- B. Color and Pattern: See finish specifications
- C. Thickness and Size: See Finish specifications
- D. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.2 RESILIENT WALL BASE

- A. Wall Base: ASTM F 1861.
- B. Products and Color: Provide wall base(s) as in finish specifications.
- C. Type (Material Requirement): TV (vinyl), TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
- D. Group (Manufacturing Method): I (solid, homogeneous)
- E. Style: See finish specifications
- F. Minimum Thickness: 0.125 inch.
- G. Height: See finish specifications
- H. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
- I. Outside and Inside Corners: premolded.

2.3 RESILIENT MOLDING ACCESSORY

- A. Description: Carpet edge, nosing for carpet or resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet, and/or accessories indicated on drawings.
- B. Material: Vinyl or Rubber.
- C. Profile and Dimensions: 1/8" thick, by not less than 1" wide and as indicated on drawings.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products, application requirements, performance criteria and substrate conditions encountered or indicated.
 - 1. ***When adhesives approved by the flooring manufacturer for application over substrates with testing results exceeding maximum acceptable moisture content are available, Contractor shall use these adhesives at no additional cost to Owner when required to avoid construction delays.***

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 3. Moisture Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft in 24 hours, unless otherwise specified by flooring manufacturer.
 - b. Perform in-situ relative humidity test, ASTM F 2170. Proceed with Installation only after substrates have a maximum relative humidity of 75%, unless otherwise specified by flooring manufacturer.
 - c. Perform other tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 RESILIENT FLOORING INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis, unless otherwise indicated on the drawings.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction and in pattern of colors and sizes as indicated on the Drawings.
- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- F. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 096500

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes modular carpet tile.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show the following:
 - 1. Existing flooring materials to be removed.
 - 2. Existing flooring materials to remain.
 - 3. Carpet tile type, color, and dye lot.
 - 4. Pattern of installation.
 - 5. Insets and borders.
 - 6. Edge, transition, and other accessory strips.
 - 7. Transition details to other flooring materials.
- C. Samples: For each color and texture required.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.7 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles 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.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.

- 1. Warranty Period: 10 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

PART 2 - PRODUCTS**2.1 CARPET TILE**

- A. Products: subject to compliance with requirements, provide the following:
 - 1. Manufacturer: As indicated on finish drawings.
 - 2. Pattern: As indicated on finish drawings.
 - 3. Color: As indicated on finish drawings.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. Adhesive must be an approved product by the specific carpet manufacturer, as to not void warranty.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- A. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive
- B. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- C. Install pattern parallel to walls and borders.

END OF SECTION 096813

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 099600 "High Performance Coatings"
 - 2. Section 099672 "Fluid Applied Insulative Coatings"

1.3 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
- C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
 - 1. Operating parts not to be painted include moving parts of operating equipment such as the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 2. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related sections include the following:
 - a. Division 3 Section "Cast-in-Place Concrete" for sealers and dust proofers

- b. Division 5 Section "Structural Steel" for shop priming structural steel.
- c. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
- d. Division 8 Section "Hollow Metal Doors and Frames" for shop priming steel doors and frames.
- e. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.

1.4 SUBMITTALS

- A. Product data of each paint system specified, including block fillers and primers.
 - 1. Provide the manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.
 - 2. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
 - 1. After color selection, the Architect will furnish color chips for surfaces to be coated.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label analysis.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire hazards and health hazards resulting from handling, mixing and application.

1.7 PROJECT CONDITIONS

- A. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg.F.

- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg.F.
- C. Do not apply paint in snow, rain, fog or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.
 - 1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat 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 best-quality paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary names used herein refer to Sherwin-Williams Co. products, unless otherwise indicated. Equivalent products of ICI Glidden, Benjamin Moore & Co., Pittsburgh Paints, Porter Paint Co., or Pratt & Lambert will be acceptable in lieu of The Sherwin-Williams Co. products. If Contractor elects to use equivalent products of any of these manufacturers he shall submit an analysis of such products to Architect for approval in accordance with Division 1 Specification Sections. The comparative analysis shall show the equivalent to Sherwin-Williams Co. products for each proposed product. Architect's judgment is final as to whether products are equivalent.

2.2 COLORS AND FINISHES

- A. Surface treatments, and finishes, are indicated in "schedules" of finishes in contract documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: 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 the 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.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
 2. Cementitious Materials: Prepare concrete, concrete masonry block, 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 the 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 where moisture content exceeds that permitted in manufacturer's printed directions.
 3. Wood: Remove surface dirt, oil, or grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

- b. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood.
- 4. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.
 - a. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- 5. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
 - a. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
 - b. Stir materials before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
 - c. Use only thinners approved by the paint manufacturer, and only within recommended limits.
- 6. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the 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.

3.3 APPLICATION

- A. General: Apply paint in according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 1. Paint colors, surface treatments, and finishes are indicated in "schedules."
 - 2. Provide finish coats that are compatible with primers used.
 - 3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
 - 4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
 - 5. The term exposed surfaces includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
 - 6. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
 - 7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.

8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 9. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
 10. Sand lightly between each succeeding enamel or varnish coat.
 11. Omit primer on metal surfaces that have been shop-primed and touch up painted.
- B. Scheduling Painting: Apply first coat material 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 the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. 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 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 paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.
1. Brushes: Use brushes best suited for the material applied.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- E. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the 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.
- F. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth 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.
- J. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.4 CLEANING

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

3.5 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
- B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

- A. Provide paint systems for, but not necessarily limited to, the following substrates:
- B. System EP-1, Waterbased Alkyd Urethane Enamel / Semi-Gloss or Gloss Enamel Finish:
 - 1a. First Coat – Ferrous Metals: S-W B50WZ4 Kem Bond HS High Solids Alkyd Universal Metal Primer (may be omitted if shop primed). Not less than 2.0 mils dry film thickness (dft).
 - 1b. First Coat – Galvanized Metals: S-W B66W1310 Pro Industrial Pro-Cryl Universal Primer (may be omitted if shop primed). Not less than 2.0 mils dry film thickness (dft).
 - 2. Second Coat: S-W B53W2151 Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss or B53W2051 Pro Industrial Waterbased Alkyd Urethane Enamel Gloss
 - 3. Third Coat: S-W B53W2151 Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss or B53W2051 Pro Industrial Waterbased Alkyd Urethane Enamel Gloss
Not less than 1.7 mils dry film thickness (dft) per coat, excluding first coat.

Apply to the following exterior non-ferrous zinc metal surfaces scheduled or indicated to receive alkyd/gloss enamel finish:

 - Hollow metal doors and frames, including interior surfaces.
 - Steel lintels.
 - Steel bollards.
 - Exterior PEMB Frames and Columns.
- C. System EP-2, Acrylic DTM - Semi-gloss Finish:
 - 1a. First Coat: – Ferrous Metals: S-W B50WZ4 Kem Bond HS High Solids Alkyd Universal Metal Primer DTM Primer/Finish B66W11 (may be omitted if shop primed). Not less than 2.0 mils dry film thickness (dft).
 - 1b. First Coat - Galvanized Metals: S-W B66W1310 Pro Industrial Pro-Cryl Universal Primer (may be omitted if shop primed). Not less than 2.0 mils dry film thickness (dft).
 - 2. Second Coat: S-W B66W1151 Pro Industrial DTM Acrylic Semi-Gloss
 - 3. Third Coat: S-W B66W1151 Pro Industrial DTM Acrylic Semi-Gloss
Not less than 1.8 mils dry film thickness (dft) per coat, excluding first coat.

Apply to the following exterior ferrous metal surfaces scheduled or indicated to receive semi-gloss latex finish:

Miscellaneous ferrous metal.

3.7 INTERIOR PAINT SCHEDULE

A. Provide paint systems for, but not necessarily limited to, the following substrates:

B. System IP-1, Latex-Enamel/Semi-Gloss Finish:

1a. First Coat (CMU Only): S-W PrepRite Interior/Exterior Block Filler, B25W25.

1b. First Coat (Smooth Concrete): LX02W0050 Loxon Concrete & Masonry Primer/Sealer - Interior/Exterior Latex

2. Second Coat: B31W2651 ProMar 200 Zero VOC Interior Latex Semi-Gloss.

3. Third Coat: B31W2651 ProMar 200 Zero VOC Interior Latex Semi-Gloss.

Not less than 1.5 mils dry film thickness (dft) per coat, excluding first coat.

Apply to the following interior surfaces scheduled or indicated to receive latex-enamel/semi-gloss finish:

Concrete masonry units.

Exposed concrete walls.

C. System IP-2, 1 Waterbased Alkyd Urethane Enamel – Semi-Gloss Finish:

1. First Coat: S-W B66W11 Pro Industrial DTM Acrylic Primer/Finish (may be omitted if shop primed).

Not less than 2.5 mils dry film thickness (dft).

2. Second Coat: S-W B53W2151 Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss

3. Third Coat: S-W B53W2151 Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss

Not less than 1.6 mils dry film thickness (dft) per coat, excluding first coat.

Apply to the following interior surfaces scheduled or indicated to receive a semi-gloss finish:

Steel railings.

Steel ladders.

Hollow metal doors and frames.

Hollow metal borrowed lights.

Access doors.

PEMB Frames and Columns.

F. System IP-5, Latex Eg-Shel Finish:

1. First Coat: B28W2600 ProMar 200 Zero VOC Interior Latex Primer (tinted to match second coat).

Not less than 1.2 mils dry film thickness (dft).

2. Second Coat: B20W12651 ProMar 200 Zero VOC Interior Latex Eg-Shel.

3. Third Coat: B20W12651 ProMar 200 Zero VOC Interior Latex Eg-Shel

Not less than 1.6 mils dry film thickness (dft) per coat, excluding first coat.

Apply to the following interior surfaces scheduled or indicated to receive latex eg-shel finish:

Drywall walls.

G. System IP-6, Latex Flat Finish:

1. First Coat: B28W2600 ProMar 200 Zero VOC Interior Latex Primer (tinted to match second coat). Not less than 1.2 mils dry film thickness (dft).
2. Second Coat: B30W12651 ProMar 200 Zero VOC Interior Latex Flat.
Not less than 1.4 mils dry film thickness (dft).
3. Third Coat: B30W12651 ProMar 200 Zero VOC Interior Latex Flat.

Apply to the following interior surfaces scheduled or indicated to receive latex flat finish:
Drywall ceilings

H. System IP-7, PreCatalyzed Waterbased Epoxy Semi-Gloss Finish:

1. First Coat: B28W2600 ProMar 200 Zero VOC Interior Latex Primer.
Not less than 1.2 mils dry film thickness (dft).
2. Second Coat: S-W . K46W1151 Pro Industrial PreCatalyzed Waterbased Epoxy - Semi-Gloss
3. Third Coat: S-W K46W1151 Pro Industrial PreCatalyzed Waterbased Epoxy - Semi-Gloss
Not less than 1.7 mils dry film thickness (dft) per coat, excluding first coat.

Apply to the following interior surfaces scheduled or indicated to receive epoxy semi-gloss finish:
Drywall walls and ceilings in toilet rooms.
Drywall walls and ceilings in wet rooms.

L. System IP-11, Acoustical Tile and Ceiling Finish:

1. Prepare existing ceiling tiles and exposed grid as recommended by coating manufacturer.
2. First Coat: ProCoat "ProCoustic" Acoustical Tile and Ceiling Coating
Spray apply at 300 square feet per gallon coverage

Apply to the following interior surfaces scheduled or indicated to receive acoustical tile and ceiling finish:

Existing acoustical ceiling tiles and exposed metal grid.

END OF SECTION 099100

SECTION 099600 - HIGH-PERFORMANCE COATINGS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of finish-coat product indicated.
- C. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.5 QUALITY ASSURANCE

- A. Master Painters Institute (MPI) Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.
- B. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..

- b. Other Items: Architect will designate items or areas required.
- 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
- 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

- 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- 2. Provide products of same manufacturer for each coat in a coating system.

B. Colors: As indicated in color schedule or selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (CMU): 12 percent.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

- B. Remove plates, machined surfaces, and similar items already in place 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, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- D. Concrete Substrates: 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.
- E. CMU Substrates: Remove 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.
- F. Steel Substrates: Remove rust and loose mill scale using methods recommended in writing by coating manufacturer.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 HIGH-PERFORMANCE COATING SCHEDULE

- A. Interior Concrete Substrates: Boot Wash including curb.
 - 1. System- HPC-1, General Polymer Floors (Sherwin-Williams or approved equal):
 - a. Primer: GP 3579 Standard Epoxy Primer
 - b. Resinous FLooring: GP 3561 Epoxy Resin Glaze and a broadcast aggregate. Applied by broadcast to provide a minimum 1/8" thickness.
 - c. Top Coat: GP 3744 High Performance CR Epoxy & Binder Resin

END OF SECTION 099600

SECTION 099672 – FLUID APPLIED INSULATIVE COATINGS**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

A. Section includes a spray-applied insulative coating including primer, insulative coating and topcoat for the following applications:

1. Applied to steel penetrating the exterior envelope, from 24 inches outboard of the face of the wall to 24 inches inside the face of metal framing; including the full depth of the penetration.

1.2 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 05 12 00 Structural Steel.
2. Section 05 50 00 Metal Fabrications.

1.3 SUMMARY

A. This Section includes surface preparation and application of fluid applied insulation coating systems where PEMB steel penetrates the building envelope from interior to exterior.

1.4 REFERENCES

A. American Institute of Steel Construction (AISC)

1. AISC 303-05 Section 10 – Erection and storage of coated material during shipment and site handling shall be protected to minimize field touch up.

B. American Society of Testing and Materials (ASTM)

1. ASTM D638 - Standard Test Method for Tensile Strength
2. ASTM D695 - Standard Test Method for Compressive Strength
3. ASTM D790 - Standard Test Method for Flexural Strength
4. ASTM D4624/ISO 4624 - Standard Test Method for Bond Strength
5. ASTM D2240 - Standard Test Method for Determining Durometer Hardness
6. ASTM E84 - Surface Burning Characteristics
7. ASTM C 1057 - Safe to Touch

C. Association of the American Walls and Ceilings Industries (AWCI)

D. The Society of Protective Coatings (SSPC)

1. SSPC SP-6: Commercial Blast Cleaning Standard
2. SSPC PA-1: Shop, Field and Maintenance coatings
3. SSPC PA-2: Measurement of Dry Paint Thickness with Magnetic Gauges

1.5 SYSTEM DESCRIPTION

A. The liquid applied thermal break acrylic material shall be applied at the required thickness specified by the manufacturer in order to mitigate thermal bridging. In no case shall the K-value of the liquid applied thermal break be more than 0.040 W/mK.

1.6 SUBMITTALS

A. Product Data: Submit product data including manufacturers technical data indicating product performance characteristics, performance and limitation criteria.

B. Manufacturer's Instructions: Submit manufacturer written installation instructions.

C. Applicator Qualifications: Submit applicators current certification as a manufacturer trained applicator.

D. Performance Documentation: Submit published design listings for insulation value ratings and product thickness. Include evidence that the liquid applied thermal break testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of technical personnel.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing product in this section with a minimum of 2 years documented experience in manufacturing insulative technology.

B. Applicator: Company specializing in applying the work of this section with documented experience and trained by the manufacturer.

C. Fluid Applied Thermal Break Acrylic system shall be the complete system from a sole source consisting of primer, acrylic thermal break material and topcoat.

D. Mock-up:

1. Minimum thirty days prior to application in any area, provide mock-up Samples of thermal break materials in accordance with the following requirements:

a. Provide minimum two square feet on representative substrate, where directed by the Engineer, for each different thickness and finish of required for the work.

b. Provide mock-up areas that comply with thickness, density application, finish texture, and color.

c. Inspect mock-up areas within one hour of application for variance due to shrinkage, temperature, and humidity.

- d. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary to meet required installation, finish, and color requirements.
- e. Continue to provide mock-up areas until acceptable areas are produced.
- f. Acceptable areas shall constitute standard of acceptance for method of application, thickness, finish texture, and color requirements, for fluid applied thermal break material applications.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in manufacturers' original, sealed, undamaged container with identification label intact. Packaged materials shall bear the appropriate labels, seals.
- B. Storage: Materials shall be stored in strict accordance with manufacturers documented instructions.
- C. Documentation: All batch number, product identification and quantities shall be recorded on appropriate QC documents. A copy of the transport document and manufacturers conformance certificate shall be attached to the material delivery on site.

1.9 PROJECT/SITE CONDITIONS

- A. Project Environmental Requirements: Substrate and air temperature shall be in accordance with the manufacturers' requirements.
 - 1. Protect work area from windblown dust and rain. Protect adjacent areas from over spray of material.
 - 2. Provide ventilation in areas to receive work of this section during application and minimum 24 hours after application.
- B. Temperature and Humidity Requirements: Maintain air temperature and relative humidity in areas where products will be applied for a time period before during and after application as recommended by manufacturer.
 - 1. Do not apply Fluid Applied Acrylic Thermal Break when temperature of substrate and/or surrounding ambient air temperature is below 45° F. Temporary protection and heat shall be maintained at this minimum temperature for 24 hours before, during and 24 hours after material application.
 - 2. Steel substrate temperature shall be a minimum of 5° F (3° C) above the dew point of the surrounding air for a period of 24 hours prior, during the application of the material and 24-hour cure period.
 - 3. If necessary, for job schedule, the General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.
 - 4. The relative humidity of the application area shall not exceed a maximum of 85% 24 hours prior, during and 24 hours after the application of the material. The relative humidity shall not exceed 75% throughout the application and curing of the decorative topcoat finish.

1.10 WARRANTY

- A. Provide a manufacturer's warranty and applicators workmanship warranty under the provisions detailed in AIA MasterSpec®, current edition.

PART 2 - PRODUCTS**2.0 FLUID APPLIED INSULATION COATING GENERAL**

A. Materials Compatibility:

1. Provide shop and field 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.
2. Provide products of same manufacturer for each coat in a coating system.

2.1 MANUFACTURERS

- A. Products specified are manufactured by Tnemec Company Incorporated, 6800 Corporate Drive, Kansas City, Missouri 64120-1372, (800) 863-6321, www.tnemec.com, and are specified as a standard of quality. Local Representative is Coating Solutions, LLC, Eureka, Missouri 63025, Mike Cerutti, 636-938-9292.

- B. Materials specified herein shall not preclude consideration of equivalent or superior materials. Suggested equivalent materials or other substitutions shall be submitted to specifier for consideration in compliance with substitution procedures in Section 01 25 00 of this Project Manual and include the following:

1. Submittals shall be provided no later than (10) days after Owner/Owner's Agent letter of Notice to Proceed.
2. Requests for substitution shall include evidence of satisfactory past performance in similar environment.
3. Substitutions will not be considered that change the number of coats or do not meet specified dry film thicknesses.
4. Manufacturer's certified test reports showing the substitute product(s) performance as outlined in Paragraph 2.15 shall be submitted.
5. After second submittal, Architect/Engineer/ Owner or Owner's Agent hourly rates will be charged to review further submittals.

- C. Bidders desiring to use coatings other than those specified shall submit those with their proposal based on the specified materials, together with the information required in Paragraph 1.5 above, and indicate the sum which will be added to or deducted from the base bid should alternate materials be accepted.

2.2 PRIMERS

- A. Water-Based Cementitious Epoxy (concrete masonry unit):

1. Tnemec Series 1224 Epoxoline WB

- 1) VOC Content: 1 gram/liter
- 2) Color: 1288 Off-White
- 3) Requirements:
 - a) Abrasion (ASTM D4060): No more than 149 mg loss after 1,000 cycles.
 - b) Adhesion to Steel (ASTM D4541): No less than 1,989 psi after 10 freeze/thaw cycles.
 - c) Humidity Resistance (ASTM D4585): No blistering, cracking, rusting, or delamination after 2,000 hours.

B. Mio-Zinc Filled Aromatic Polyurethane (Carbon Steel)

1. Tnemex Series 394-0250 PerimePrime

- 1) VOC Content: 246 grams/liter
- 2) Color: 0250 Greenish-Gray
- 3) Requirements:
 - a) Adhesion to Steel (ASTM D4541): No less than 1,150 psi.
 - b) Fire Testing (UL 263 ASTN E 119): Any UL Classified spray-applied fire resistive materials having a maximum average density of 19.5 pcf. Including W.R. Grace Monokote MK-6/HY and Isolatek (Cafco) Blaze-Shield II (Type II).
 - c) Salt Fog Corrosion (ASTM B117): No cracking or delamination of film. No more than 1/64" rust creepage at scribe and no more than 3% rusting on plane after 10,250 hours exposure. Slip Coefficient & Tension Creep: Meets AISC requirements of a Class B surface with a mean slip coefficient no less than 0.57.

2.3 THERMAL INSULATING COATING

A. Fluid-Applied Acrylic Insulation Coating

1. Tnemec Series 971 Aerolon® Acrylic

- a. VOC Content: 1.9 grams/liter
- b. Solids by Volume: 76 percent.
- c. Colors: 1278 Insulation Yellow
- d. Requirements:
 - 1) Abrasion (ASTM D4060): No more than 50.2 mg loss after 1,000 cycles.
 - 2) Cyclic Salt Fog/UV Exposure (ASTM D5894): No blistering, cracking, rusting or delamination of film after 5,000 hours.
 - 3) Humidity Resistance (ASTM D4585): No blistering, cracking, rusting, or delamination after 2,000 hours.
 - 4) Immersion (ASTM D870): No blistering, cracking, rusting, or delamination after six months continuous tap water immersion.

- 5) Surface Burning Characteristics (ASTM E84): Class A
- 6) Thermal Conductivity (ASTM C518): No greater than 0.0356 W/m-°K or 0.2468 BTU-in/ft²-hr-°F.
- 7) NORSOK M-501 ISO 20340: Passed 25 cycles.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. All surfaces to receive the specified Tnemec Series 971 Aerolon® shall follow the manufacturer's printed instructions and be clean, dry and free of oil, grease, loose mill scale, dirt, dust or other foreign substances which would impair bond of the material to the substrate.
- D. Other corrections of the surfaces to receive the Fluid Applied Insulation Coating material shall be the responsibility of the Contractor, at no additional cost to the Owner.
- E. Application of the primer, Series 971 Aerolon®, and topcoat shall not commence until the contractor, applicator and inspector have examined the surfaces to receive the primer and determined the surfaces are acceptable to receive the primer and Aerolon®. Commencement of application means acceptance of substrate.
- F. Verify that substrate and workspace temperature and humidity conditions are in accordance with manufacturers recommendations.

3.2 SURFACE PREPARATION

- A. Prepare surfaces in accordance with manufacturer's instructions.
- B. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated with thermal break coating.
- C. Weld spatter and defect shall be ground smooth prior to commencement of primer and fluid applied thermal break material.
- D. Primer shall not be applied to prepared substrate until the area has been adequately vented to remove all airborne dust. Prior to the application of any coating material, the blast products, dust and debris, shall be removed by vacuuming
- E. Steel Substrates: Remove rust and loose mill scale.
 - 1. Fabrication defects:
 - a. Correct steel and fabrication defects revealed by surface preparation.
 - b. Remove weld spatter and slag.

- c. Round sharp edges and corners of welds to a smooth contour.
 - d. Smooth weld undercuts and recesses.
 - e. Grind down porous welds to pinhole-free metal.
 - f. Remove weld flux from surface.
 2. Ensure surfaces are dry.
 3. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3, unless otherwise specified.
- F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
1. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions.
- G. Concrete Surfaces (where thermal break is needed):
1. Grind all surfaces to receive primer.
 2. Apply Series 1224 Epoxoline WB

3.3 APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions.
1. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
 2. Keep containers closed when not in use to avoid contamination.
 3. Do not use mixed coatings beyond pot life limits.
 4. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- B. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- C. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- D. Apply primer at thickness recommended by manufacturer.
- E. Apply Series 971 Aerolon® Thermal Insulative Coating at as specified in Section 3.9 Coating Schedule.
- F. Apply topcoat at thickness recommended by the manufacturer.
- G. Final Dry Film Thickness (DFT) shall be measured with a dry film thickness gauge.
- H. The steel deck is not to be sprayed unless otherwise indicated.

3.4 REPAIR

- A. Materials and Surfaces Not Scheduled to Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. Damaged Coatings: All patching and repair to material, due to damage by other trades, shall be performed under this section and paid for by the trade responsible for the damage. Patching shall be performed by applicators certified by the manufacturer and applied in accordance with the manufacturer application instructions.
- C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.5 FIELD QUALITY CONTROL

- A. The Owner will engage an independent testing laboratory inspect and verify the application of material in accordance with the provisions Themec Company.
 - 1. Material inspection and testing shall be performed 24 hours after completion of final application coat.
 - 2. The results of the above tests shall be made available to all parties at the completion of each pre-designated area and approval.
 - 3. In-place material not in compliance with the specified thickness requirements shall be corrected prior to final acceptance.
- B. The dry film thickness (DFT) of the applied material shall be measured with a non-destructive coating thickness gage after material has completely cured. All measurements shall be documented in writing and furnished to the Owner.
- C. Manufacturer's Technical Services: Coordinate with coating manufacturer's technical service department or independent sales representative for current technical data and instructions.

3.6 CLEANING AND PROTECTION

- A. Remove overspray materials from surfaces not required to be thermally protected.
- B. Protect surfaces of coating systems from damage during construction.
- C. Touch-up, or repair damaged products before Substantial Completion.

3.7 ONE-YEAR INSPECTION

- A. Owner will set date for one-year inspection of coating systems.
- B. Inspection shall be attended by Owner, Contractor, Architect, and manufacturer's representative.

C. Repair deficiencies in coating systems as determined by Architect in accordance with manufacturer's instructions.

3.8 FIELD QUALITY CONTROL

A. The engineer shall select, and the owner will pay for an independent testing laboratory to inspect and verify the application of material in accordance with the provisions of Tnemec Company.

B. The Fluid Applied Thermal Break material inspection and testing shall be performed 24 hours after completion of final application coat.

1. The results of the above tests shall be made available to all parties at the completion of each pre-designated area and approval.

C. In-place material not in compliance with the specification requirements shall be corrected prior to final approval.

D. The dry film thickness (DFT) of the applied material shall be measured with a non-destructive coating thickness gauge after material has completely cured. All measurements shall be documented in writing and furnished to the Owner.

3.9 FLUID APPLIED INSULATION COATING SCHEDULE

A. Steel Members Penetrating Exterior Building Envelope/Inside Face of Metal Framing/Concrete Slab Edges/Aluminum Window Frames, Condensation Control:

1. Fluid Applied Thermal Break System:

- a. Surface Preparation: SSPC-SP2-3 or better.
- b. First Coat (Shop or Field): Series 394-0250 PerimePrime, DFT of 2.5 to 3.5 mils per coat.
- c. Second Coat (Shop or Field): Series 971 Aerolon Acrylic, DFT of 45.0 to 50.0 mils per coat. Multiple coats may be required to achieve specified thickness.
- d. Third Coat (Shop or Field): Series 971 Aerolon Acrylic, DFT of 45.0 to 50.0 mils per coat. Multiple coats may be required to achieve specified thickness.
- e. Fourth Coat: Series 1028 Enduratone, DFT of 2.0 to 3.0 mils per coat.

END OF SECTION 099672

SECTION 102113 - TOILET COMPARTMENTS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes baked-enamel, and phenolic-core units as follows:
 - 1. Toilet Enclosures: Floor anchored / Overhead braced
 - 2. Urinal Screens: Wall hung.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, details, and attachments to other work.
- C. Samples: For each exposed finish.

PART 2 - PRODUCTS**2.1 METAL UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASI Accurate Partitions Corporation.
 - 2. All American Metal Corp.
 - 3. American Sanitary Partition Corporation.
 - 4. Bradley Corporation; Mills Partitions.
 - 5. Flush Metal Partition Corp.
 - 6. General Partitions Mfg. Corp.
 - 7. Global Steel Products Corp.

8. Hadrian Inc.
9. Knickerbocker Partitions Corp.
10. Metpar Corp.
11. Sanymetal; a Crane Plumbing Company.

B. Baked-Enamel Units: Facing sheets and closures fabricated from ASTM A 591/A 591M, 80Z (electrolytically zinc-coated) or ASTM A 653/A 653M (hot-dip galvanized or galvanized), commercial steel sheet for exposed applications, that is mill phosphatized, and selected for smoothness.

1. Finish: Manufacturer's standard pigmented, organic coating.
 - a. Color: One color in each room as selected by Architect from manufacturer's full range of colors. Textured finishes are available from some manufacturers, but textures vary.

C. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets are pressure laminated to core material. Units have continuous, interlocking molding strip or lapped and formed edge closures. Exposed surfaces are free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections. Corners are sealed by welding or clips. Exposed welds are ground smooth.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
4. Urinal-Screen Construction: Similar to panels, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches (32 mm) thick.

D. Pilaster Shoes and Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304.

E. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.2 PHENOLIC-CORE UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Accurate Partitions Corporation.
2. American Sanitary Partition Corporation.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation; Mills Partitions.
5. Flush Metal Partition Corp.
6. General Partitions Mfg. Corp.
7. Global Steel Products Corp.

8. Knickerbocker Partitions Corp.
9. Metpar Corp.
10. Partition Systems, Inc.
11. Sanymetal; a Crane Plumbing Company.
12. Young Group, Ltd. (The); DesignRite Partitions.

B. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch thick doors and pilasters and minimum 1/2-inch thick panels.

1. Facing Sheet Color: One color in each room as selected by Architect from manufacturer's full range of colors.
2. Core Color: Manufacturer's standard dark color.

C. Pilaster Shoes and Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304.

D. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.
2. Full-Height (Continuous) Type at urinal screen: Manufacturer's standard design; stainless steel.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.4 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: Unless otherwise indicated, provide 24-inch wide in-swinging doors for standard toilet compartments and 36-inch wide out-swinging doors with a minimum 32-inch wide clear opening for compartments indicated to be accessible to people with disabilities.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 2. Stirrup Brackets: Secure panels to walls and to pilasters with not less than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102226 - OPERABLE PANEL PARTITIONS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. ASTM E 90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- C. ASTM E 557 - Standard Practice for the Installation of Operable Partitions.
- D. Related Sections:
 - 1. Division 3, Section "Cast-In-Place Concrete" for concrete tolerances required.
 - 2. Division 5, Sections "Structural Steel" and "Metal Fabrications" for primary structural support, including pre-punching of support members by steel supplier in accordance with template supplied by operable partition supplier's template.
 - 3. Division 6, Section "Carpentry" for wood framing and supports, and blocking at head and jambs as required.
 - 4. Division 9, Section "Gypsum Board Assemblies" for metal framing and gypsum board wall systems adjacent to operable partitions including blocking and insulation, and wall and ceiling framing at head and jambs.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Manually operated, paired-panel partitions.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 3. Coordination Drawings: Drawn to scale and coordinating operable panel partition installation with suspended ceiling components and structural members to which suspension systems will be attached.
- C. Samples: For each type of finish, covering, or facing indicated.
- D. Product test reports.
- E. Maintenance data.
- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Fire-Test-Response Characteristics: Provide operable panel partitions with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
 3. Fire Growth Contribution: Wall coverings shall comply with acceptance criteria of the prevailing building code and requirements of Authorities Having Jurisdiction.
- C. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: The design for operable panel partitions is based on Hufcor 642. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. KWIK-WALL Company.
 - 2. Modernfold, Inc.

2.2 MATERIALS

- A. Steel Frame: Steel sheet, manufacturer's standard nominal specified thickness for uncoated steel.
- B. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - 1. Frame Reinforcement: Manufacturer's standard steel or aluminum.
- C. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard thickness.
- D. Gypsum Board: ASTM C 36/C 36M.

2.3 OPERABLE PANELS

- A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- B. Dimensions: Fabricate operable panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
- C. STC: Not less than 50

- D. Panel Closure: Manufacturer's standard.
- E. Horizontal trim shall be of aluminum.
- F. Hinges on basic panels shall be of steel and project no more than ¼" beyond panel faces. Each pair of panels to have a minimum of three hinges.
- G. Hardware: Manufacturer's standard as required to operate panel partition and accessories; with decorative, protective finish.

2.4 SEALS

- A. General: Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
 - 1. Manufacturer's standard seals.
 - 2. Seals made from materials and in profiles that minimize sound leakage.
 - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces when operable panel partition is extended and closed.
- B. Horizontal Bottom Seals: Shall be retractable, provide up to 2" nominal operating clearance, and exert downward force when fully extended. Constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
- C. Horizontal Top Seals: Shall be retractable, provide 1" nominal operating clearance, and exert upward force when extended. All panels, including pass door panels and lever closure panels must have retractable top and bottom seals.
 - 1. Mechanically Operated: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 1-1/2-inch between retracted seal and floor finish.

2.5 FINISH FACING

- A. General: Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Color/Pattern: As selected by Architect from manufacturer's full range.

2.6 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between

bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.
- E. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

2.7 ACCESSORIES

- A. Pass Doors: Fabricated to comply with local and national accessibility requirements. Swinging door built into and matching panel materials, construction, acoustical qualities, finish, and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
 - 1. Single Pass Door: 36 by 84 inches, with the following:
 - a. Door Seals: Mechanically operated floor seal on panels containing pass doors, sweep floor seals.
 - b. Panic hardware.
 - c. Concealed door closer.
 - d. Exit Sign: Recessed, self-illuminated.
 - e. Lock: Key-operated lock cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
- B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

PART 3 - OPERATION

- 3.1 Retractable horizontal seals shall be activated by a removable quick-set operating handle located approximately 42" from the floor in the panel edge.
 - A. All retractable seals in each hinged pair shall be operated simultaneously.
 - B. Seal activation requires approximately 15 lbs. of force per panel and approximately a 190 degree turn of the removable handle.

- 3.2 Final partition closure to be by expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45" from the floor in the panel face and be accessed from either side of the panel. The jamb shall be equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4" – 6" by turning the removable operating handle.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 INSTALLATION

- A. General: Comply with operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

4.3 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware, and other moving parts.
- B. Adjust pass doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.

4.4 FIELD QUALITY CONTROL

- A. NIC Testing: Owner may Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Methodology: Perform testing of installed operable panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than the NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.

- C. Testing Extent: Testing agency shall randomly select one operable panel partition installation(s) for testing.
- D. Repair or replace operable panel partitions within areas where test results indicate partitions do not comply with requirements, and retest partitions.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired, replaced, or additional work with specified requirements.

4.5 CLEANING

- A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

4.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 102226

SECTION 102800 - TOILET AND BATH ACCESSORIES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Private-use bathroom accessories.
 - 4. Warm-air dryers.
 - 5. Underlavatory guards.
 - 6. Custodial accessories.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule:
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.
- C. Closeout submittals:
 - 1. Warranty
 - 2. Operation & Maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated on Drawings. Subject to compliance with requirements, provide the named product or an equivalent product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.

2.2 WARM-AIR DRYERS

- A. Basis-of-Design Product: The design for accessories is based on products indicated on Drawings. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Dryer, Inc.
3. American Specialties, Inc.
4. Bobrick Washroom Equipment, Inc.
5. Bradley Corporation.
6. Excel Dryer Corporation.
7. General Accessory Manufacturing Co. (GAMCO).
8. World Dryer Corporation.

- B. Electrical Requirements: Coordinate with Electrical Drawings or Electrical Contractor.

2.3 UNDERLAVATORY GUARDS

- A. Basis-of-Design Product: The design for underlavatory guards is based on products indicated in Division 22 or Plumbing Drawings. Subject to compliance with requirements, provide the named product or an equivalent product by one of the following:

1. Plumberex Specialty Products, Inc.
2. TCI Products.
3. Truebro, Inc.

2.4 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated on Drawings. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.

PART 3 - MATERIALS GENERAL

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- F. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- G. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- H. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

3.2 FABRICATION

- A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

- C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.
- D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
- E. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.
- F. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
 - 1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
- G. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

END OF SECTION 102800

SECTION 104230 - DIMENSIONAL LETTERS**1 GENERAL****1.1 SUMMARY**

- A. Related Documents: Provisions established within the General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.
- B. Section Includes:
 - 1. Exterior dimensional letters of cast metal construction for Building Entry signage.

1.2 QUALITY ASSURANCE

- A. Supplier: Obtain all products in this section from a single supplier.
- B. Installer: Installation shall be performed by installer specialized and experienced in work similar to that required for this project.

1.3 SUBMITTALS

- A. Submit in accordance with requirements of Division 1.
- B. Product Data: Submit product data for specified products. Include material details for each sign specified.
- C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.
- D. Samples: Submit supplier's standard color chart for selection purposes and selected colors for verification purposes.
- E. Installation: Submit supplier's installation instructions.
- F. Closeout Submittals:
 - 1. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
 - 2. Submit warranty documents specified herein.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of Division 1.
 - 1. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
 - 2. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 3. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
 - 4. Handle products in accordance with manufacturer's instructions.

1.5 WARRANTY

- A. Project Warranty: Comply with requirements of Division 1.
- B. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
 - 1. Warranty Period: Two years from product ship date. Warranty specifically excludes letter mounting substrate.

2 PRODUCTS

2.1 SIGNAGE SYSTEMS

- A. Acceptable Manufacturers:
 ASI Modulex Sign Systems, Steve Calhoun, 2200 Olive Street, St. Louis, MO 63103
 (314) 421-2288 voice, (314) 421-3164 facsimile

Cornerstone Sign & Decal, 11900 Carrier Ct, Louisville KY 40299
 Office (502)-968-8759
sales@cornerstonesign.com

Substitutions: Submit in accordance with Division 1 Section 016000.

- B. Acceptable Product: ASI LC Series Cast Metal Dimensional Letters.
 Cornerstone Flat Cut metal letters.

- C. Material:
 - 1. Cast Aluminum in Dark Bronze Anodized finish.
- D. Fabricated Letters:
 - 1. Letterstyle: As shown on drawings.
 - 2. Letter Cap Height: As shown on drawings.
 - 3. Letter Depth: 1/2" minimum.

- E. Mounting Method: Projected Mount.

2.2 FABRICATION – GENERAL

- A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- B. Design, fabricate, and install sign assemblies to prevent buckling, opening up of joints, and over-stressing of welds and fasteners.
- C. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
- D. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
- E. Create signage to required sizes and layout. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

3 EXECUTION**3.1 EXAMINATION**

- A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.
- B. Scheduling of installation by Owner or it's representative implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer's acceptance of substrate and conditions.

3.2 INSTALLATION

- A. Install product in accordance with supplier's instructions.
- B. Install product in locations indicated using mounting methods recommended by sign manufacturer and free from distortion, warp, or defect adversely affecting appearance.
- C. Install product level, plumb, and at heights indicated.
- D. Install signs within the following tolerances and in accordance with manufacturer's recommendations:
 - 1. Exterior Signs: Within 1 inch vertically and horizontally of intended location.

3.3 CLEANING, PROTECTION, AND REPAIR

- A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 10 feet.
- B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project in accordance with provisions in Division 1.

3.4 SIGN SCHEDULE

- A. Schedule: Refer to Drawings for sizes, locations, and layout of signage types, sign text copy, and graphics. Vector art will be provided by the Owner.

END OF SECTION

SECTION 104400 - FIRE-PROTECTION SPECIALTIES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets.
 - 3. Mounting brackets for fire extinguishers.
- B. See Division 21 Section "Fire-Suppression System" for hose systems, racks, and valves.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include door hardware, cabinet type, trim style, panel style, and details of installation.
 - 3. Show location of knockouts for hose valves.
- B. Samples: For each exposed cabinet finish.
- C. Maintenance data.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

- C. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.6 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers and any fire protection equipment indicated are accommodated.
- B. Apply decals or vinyl lettering on field-painted fire-protection cabinets after painting is complete.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1/8 thick, Class 1 clear.
- C. Acrylic Bubble: One piece.

2.3 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. JL Industries, Inc.; Div of Activar Construction Products Group.
 - 2. Larsen's Manufacturing Company.
 - 3. Potter Roemer; Div. of Smith Industries, Inc.

- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated. **VERIFY TYPE AND SIZE WITH FIRE MARSHAL PRIOR TO SUPPLYING UNITS.**
 - 1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B
- C. Wet-Chemical Type for Kitchens with stove-top/oven or commercial cooking equipment: UL-rated 2-A:K, 2.5-gal. nominal capacity, with potassium acetate based chemical in stainless-steel container; with pressure-indicating gage. Provide one (1) at each Kitchen area. If not shown on Drawings, coordinate location with Architect.
- D. Multipurpose Dry-Chemical Type in Steel Container for General Locations: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- E. Clean Agent Type for Computer Rooms: UL-rated 2-A:10-B:C, 13-lb. nominal capacity, in powder coated steel container; with pressure-indicating gage. Provide one (1) at each Computer Room. If not shown on Drawings, coordinate location with Architect.

2.4 FIRE-PROTECTION CABINET

- A. Manufacturers:
 - 1. JL Industries, Inc.; Div of Activar Construction Products Group.
 - 2. Larsen's Manufacturing Company.
 - 3. Potter Roemer; Div. of Smith Industries, Inc.
- B. Cabinet Type: Suitable for fire extinguisher and/or if indicated: hose valve, hose, rack, and valve.
- C. Cabinet Construction: Nonrated, or rated for 1 or 2 hours if indicated.
- D. Cabinet Material: Enameled-steel sheet.
- E. Semirecessed Cabinet for use where wall depth will not accommodate recessed model: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2 or 3 inch backbend depth.
- F. Door Material: Steel sheet.
- G. Door Style: Vertical duo panel with frame
- H. Door Glazing: Tempered float glass (clear)
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened, or Pressure-sensitive vinyl letters for use on field painted cabinets.
 - 3) Lettering Color: Red
 - 4) Letter size: 2 inch.
 - 5) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet and door; White with minimum dry film thickness of 2 mils.
2. Manufacturer's standard stainless steel for the following:
 - a. Exterior of cabinet door, and trim

2.5 MOUNTING BRACKETS

A. Manufacturers:

1. JL Industries, Inc.; Div of Activar Construction Products Group.
2. Larsen's Manufacturing Company.
3. Potter Roemer; Div. of Smith Industries, Inc.

B. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

1. Color: Black.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.6 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth.

1. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roughing-in for hose valves or racks (if required) and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- C. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.
- D. Prepare recesses for fire-protection cabinets as required by type and size of cabinet and trim style.
- E. Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- F. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- G. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- H. Identification: Apply decals or vinyl lettering at locations indicated.
- I. Fire-Rated Hose and/or Valve Cabinets: Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Center pipe within knockout.
 1. Seal through penetrations with firestopping sealant as specified in Division 7 Section "Through-Penetration Firestop Systems."
- J. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- K. Replace fire-protection cabinets that have been damaged.

END OF SECTION 104400

SECTION 105113 - METAL LOCKERS**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Metal lockers.
 - 2. Locker benches.
- B. See Division 6 Section "Rough Carpentry" for furring, blocking, and shims required for installing metal lockers and concealed within other construction before metal locker installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show base, sloping tops, filler panels, recess trim, and other accessories.
 - 2. Include locker identification system.
- C. Samples: For each exposed finish.
- D. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Accessibility Requirements: 5% of lockers provided, but not less than one (1), shall meet accessibility requirements of prevailing building code. Coordinate dispersion / locations of accessible lockers with Owner before installation.
 - 1. Provide not less than 1 shelf located between 40-48 inches above the finished floor (single tier locker).

- a. Coat hooks (if provided) are required to be below 48" AFF.
2. Provide manufactures standard signage indicating accessible locker.
3. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry and ready for metal locker installation.

1.7 COORDINATION

- A. Coordinate size and location of bases for metal lockers.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 2. Damage from deliberate destruction and vandalism is excluded.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Basis-of-Design Product: The design for each metal locker specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.
- B. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch steel mesh, with at least 70 percent open area.

- C. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- D. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 METAL LOCKERS

- A. Basis-of-Design Product: Art Metal Products, Div of Fort Knox Storage Co, AMP-1002; or a comparable product of one of the following:
 - 1. All Metal Lockers:
 - a. Art Metal Products, Div. of Fort Knox Storage Co
 - b. ASI Storage
 - c. DeBourgh Mfg. Co.;
 - d. List Industries Inc.;
 - e. Lyon Workspace Products;
 - f. Penco Products, Inc., Subsidiary of Vesper Corporation
 - g. Salsbury Industries
- B. Locker Arrangement: As indicated on Drawings.
- C. Body: Assembled by welding riveting or bolting body components together. Fabricate from unperforated, cold-rolled steel sheet with backs 0.0428 inch thick, and tops, bottoms, and shelves 0.0528 inch thick:
- D. Unperforated Sides: Fabricated from **0.0428-inch -)]** thick, cold-rolled steel sheet.
- E. Frames: Channel formed; fabricated from 0.0528-inch- thick, cold-rolled steel sheet or 0.0966-inch- thick steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
- F. Locker Base: Structural channels, formed from **0.0528-inch**-thick, cold-rolled steel sheet; welded to front and rear of side-panel frames.
- G. Perforated Doors: One-piece, fabricated from 0.0677-inch- thick, cold-rolled steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.

- H. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 - 1. Hinges: Manufacturer's standard, steel continuous or knuckle type.
- I. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
 - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic and prelocking.
 - a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with 3 latch hooks and doors less than 48 inches (1219 mm) high with 2 latch hooks; fabricated from minimum 0.1116-inch- (2.8-mm-) thick steel; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- J. Combination Padlocks: Provided by Owner.
- K. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
 - 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 - 2.
- L. Accessories:
 - 1. Continuous Base: 4 inches (102 mm) high; fabricated from 0.0677-inch- thick, cold-rolled steel sheet.
 - 2. Continuous Sloping Tops: Fabricated from minimum 0.0428-inch-thick, cold-rolled steel sheet; approximately 20-degree pitch.
 - 3. Recess Trim: Fabricated from 0.0428-inch- thick, cold-rolled steel sheet.
 - 4. Filler Panels: Fabricated from 0.0428-inch- thick, cold-rolled steel sheet.
- M. Finish: Baked enamel or powder coat.
 - 1. Color(s): As selected by Architect from manufacturer's full range.

2.4 LOCKER BENCHES

- A. Bench Tops: Manufacturer's standard 1-piece units, of the following material, minimum 9-1/2 inches wide by 1-1/4 inches thick, with rounded corners and edges:
 - 1. Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

- B. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
 - 1. Cast Iron: 1-1/2-inch- diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
 - a. Color: Match metal lockers.

2.5 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.
- B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- D. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch high.
 - 1. Coordinate final numbering scheme(s) with Owner.
- E. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.
- F. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers. Sloped top corner fillers, mitered.
- G. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practicable; finished to match lockers.
- H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.
- I. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of non-recessed metal lockers; finished to match lockers. Provide one-piece panels for double-row (back-to-back) locker ends.

2.6 STEEL SHEET FINISHES

- A. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

- B. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturers, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
 - 3. Anchor back-to-back metal lockers to floor.
- B. All-Welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - 4. Attach recess trim to recessed metal lockers with concealed clips.
 - 5. Attach filler panels with concealed fasteners.
 - 6. Attach sloping top units to metal lockers, with closures at exposed ends.
 - 7. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of non-recessed metal lockers.
- D. Fixed Locker Benches: Provide not less than 2 pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
- E. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

END OF SECTION 105113

SECTION 107500 - FLAGPOLES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.4 RELATED DOCUMENTS

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

1.5 SUMMARY

- A. This Section includes ground-set flagpoles made from aluminum.

1.6 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide flagpoles 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.
 - 2. Basic Wind Speed: 110 mph (49 m/s) 3-second gust speed at 33 feet (10 m) aboveground.

1.7 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 qualified professional engineer responsible for their prep.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Flagpole; a Kearney-National Inc. Company.
 - 2. Baartol Company Inc. (The)
 - 3. Concord Industries, Inc.
 - 4. Eder Flag Manufacturing Company, Inc.
 - 5. Ewing International.
 - 6. Michigan Flagpole Inc.

2.2 FLAGPOLES

- A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
- B. Exposed Height: 30 feet (9.1 m)
- C. Aluminum Flagpoles: Provide cone-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 (4.8 mm). Heat treat after fabrication to comply with ASTM B 597, Temper T6.
- D. Foundation Tube: Galvanized corrugated-steel foundation tube, 0.064-inch- (1.6-mm-) minimum nominal wall thickness. Provide with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-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. Provide flashing collar of same material and finish as flagpole.
- E. Flag: Provide High Wind, Commercial Grade, Polyester 5'x 8' American Flag

2.3 FITTINGS

- A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter; finished to match flagpole.
- B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
- C. Halyard Flag Snaps: Provide two swivel snap hooks per halyard with neoprene or vinyl covers.

- D. Elastomeric Joint Sealant: Single-component urethane or single-component neutral-curing silicone joint sealant complying with requirements in Division 7 Section "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, O joint substrates.

2.4 FINISHES

- A. 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: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where shown and according to manufacturer's written instructions.
- B. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- C. 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 (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107500

SECTION 111300 - LOADING DOCK EQUIPMENT**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Dock bumpers.
 - 2. Dock levelers.
 - 3. Truck restraints.
 - 4. Dock seals.
- B. See Division 5 Section "Metal Fabrications" for curb angles at edges of recessed pits and loading dock platform edge channels.
- C. See Division 26 Sections for electrical wiring and connections for loading dock equipment.

1.4 DEFINITIONS

- A. Operating Range: Maximum amount of travel above and below the loading dock level.
- B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.5 SUBMITTALS

- A. Product Data: For each type of loading dock equipment indicated. Include rated capacities.
- B. Shop Drawings: Include plans, elevations, sections, details, wiring diagrams and attachments to other work.
 - 1. Provide templates for anchors and bolts anchored to permanent construction.

- 2. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples: For each type of dock seal fabric indicated.
- D. Product Test Reports: Indicate compliance of dock levelers with requirements in MH 30.1 for determined rated capacities.
- E. Maintenance data.
- F. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Dock- Leveler Standard: Comply with MH 30.1, "Safety, Performance, and Testing of Dock Leveling Devices."
- C. Source Limitations: Obtain each type of loading dock equipment through one source from a single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Store and handle dock shelters in a manner to avoid significant or permanent damage to fabric or frame.
 - 1. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings..

1.9 COORDINATION

- A. Recessed Loading Dock Equipment: Coordinate size and location of pits to ensure proper clearances and operation of equipment.

1.10 WARRANTY

- A. Special Warranty for Dock Levelers: Manufacturer's standard form in which manufacturer agrees to repair or replace dock-leveler components that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Structural failures including cracked or broken structural support members and load-bearing welds.

Deck plate failures including cracked plate or permanent deformation in excess of ¼ inch between deck supports.

1. Warranty Period for Structural Assembly: **5** years from date of Substantial Completion.
2. Warranty Period for Hydraulic System: **10** years from date of Substantial Completion.
3. Warranty shall be for unlimited usage of the leveler for the specified rated capacity over the term of the warranty.

1.11 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of dock equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service.

- B. Continuing Maintenance Service: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard yearly maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis-of-Design Product: The design for each type of loading dock equipment is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55.
- C. Steel Tubing: ASTM A 500, cold formed.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- E. Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried.
- F. Pressure-Treated Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried, and pressure treated with waterborne preservatives to comply with AWPA C2.
- G. Steel and Iron Hardware: Hot-dip galvanized according to ASTM A 153/A 153M.

2.3 DOCK BUMPERS

- A. Basis of Design Product: Rite-Hite RHV620-11SF Dock Bumper or Comparable product by one of the following:
- B. Manufacturers:
 1. Kelley Company, Inc.; a United Dominion Company.
 2. Rite-Hite Corporation.
 3. Serco; a United Dominion Company.
- C. Steel-Face, Laminated-Tread Bumpers: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires and with 3/8-inch steel face plate of same size as rubber surface. Laminate plies under pressure on not less than two 3/4-inch diameter, steel supporting rods that are welded at one end to 1/4-inch- thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles. Weld face plate to two steel support brackets, which shall extend back to and engage 3/4-inch-diameter support rods in elongated holes, allowing steel face to float on impact.
- D. Anchorage Devices: Hot-dip galvanized.

2.4 RECESSED DOCK LEVELERS

- A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
1. Basis-of-Design Product: Rite-Hite RHH Hydraulic Dock Leveler, or a comparable product by one of the following:
 2. Manufacturers:
 - a. Blue Giant Equipment Corporation; Subsidiary of TBM Holdings, Inc.
 - b. Kelley Company, Inc.; a United Dominion Company.
 - c. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - d. Pioneer Loading Dock Equipment.
 - e. POWERAMP; Division of Systems, Inc.
 - f. Rite-Hite Corporation.
 - g. Serco; a United Dominion Company.
- B. Quality Standard: MH 30.1, "Safety, Performance and Testing of Dock Leveling Devices," except for rated capacity.
- C. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform in the following manner:
1. Vertical Travel: Provide operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact.
 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches over width of ramp.
 4. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
- D. Mechanical Operating System: Spring-operated raising and walk-down lowering of unloaded ramp. Equip units with an upward-biased-spring counterbalancing mechanism controlled by a hold-down device. Ramp raises to top limit of operating range by operating recessed control handle in ramp to disengage hold-down device. Ramp lowers below platform level with lip retracted by operating auxiliary, recessed control handle to release support legs.
1. Free-Fall Protection: Manufacturer's standard protection system to limit free fall of loaded ramps with front edge supported by truck bed.
- E. Hydraulic Operating System: Electric-powered hydraulic raising and hydraulic lowering of ramp, controlled from a remotely located push-button station. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold

reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches.

1. Remote-Control Station with Emergency Stop: Multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 12 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
- F. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
1. Hinged Lip: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, with gussets on lip and ramp for support.
 2. Toe Guards: Equip open sides of rising ramp over range indicated with metal toe guards mounted flush with ramp edges and projecting below ramp.
 3. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
 4. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
- G. Accessories:
1. Curb Angles: 3-by-3-by-1/4-inch galvanized steel curb angles for edge of recessed leveler pit, with 1/2-inch diameter by 6-inch-long concrete anchors welded to angle at 6 inches o.c.
 2. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
 3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
 4. Interlock: Leveler will not operate while overhead door is in closed position and truck restraint is not engaged.
 5. Weather Seals: Use Manufacturer's standard prefabricated rubber weather seals at sides and rear of dock leveler. [Use with horizontal levelers installed in a conditioned space.]

2.5 TRUCK RESTRAINTS

- A. General: Manufacturer's standard device designed to engage truck's rear-impact guard and hold truck at loading dock. Restraint shall consist of an iron or steel restraining arm that raises until contacting rear-impact guard. Arm shall move vertically, automatically adjusting to varying height of truck due to loading and unloading operations.
1. Basis-of-Design Product: Rite-Hite Dok-Lok Shadow Hook SHR-5000 or a comparable product by one of the following:
 2. Manufacturers:

- a. Blue Giant Equipment Corporation; Subsidiary of TBM Holdings, Inc.
 - b. Kelley Company, Inc.; a United Dominion Company.
 - c. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - d. POWERAMP; Division of Systems, Inc.
 - e. Rite-Hite Corporation.
 - f. Serco; a United Dominion Company.
- B. Restraining Capacity: Capable of restraining total gross load indicated without permanent deflection or distortion.
- C. Operating Range: Capable of restraining rear-impact guards within a range from 11 to 30 inches vertically above driveway, and from 0 to 12 inches horizontally in front of dock bumpers.
- D. Power Operating System: Manufacturer's standard electromechanical or hydraulic unit.
1. Remote-Control Station: Single-button station of the constant-pressure type, weatherproof, enclosed in NEMA ICS 6, Type 12 box. Restraint is engaged by depressing and holding button; restraint is released by releasing button.
 2. Interlock: Leveler will not operate while truck restraint is not engaged.
- E. Rear-Impact-Guard Sensor: Sensor detects presence of rear-impact guard and automatically returns to stored position if rear-impact guard is not engaged.
- F. Caution Signs: Exterior, surface mounted; with black text on yellow background, and with sign copy as follows. Provide one sign at each truck-restraint location.
1. Sign Copy in Forward and Reverse Text: "CAUTION, MOVE ON GREEN ONLY."
- G. Light Communication System: Red and green illuminated signal-light sets, with lens approximately 4 inches in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel located at interior of dock that indicates status of exterior signal lights. Provide signal-light set and control panel at each location indicated for light communication system. Enclose exterior signal-light sets in steel or plastic housing with sunshade.
1. Automatic Operation: System is activated automatically when device engages rear-impact guard. Provide on-off switch located on truck-restraint control panel.
- H. Alarm: Audible and visual system indicating that rear-impact guard is not engaged, with manual reset.
- 2.6 FOAM-PAD DOCK SEALS
- A. General: Dock seals consisting of fabric-covered foam pads designed to compress 4 to 5 inches under pressure of truck body to form an airtight seal at jambs and head of loading dock openings; of type, size, and construction indicated.
1. Manufacturers:

- a. Blue Giant Equipment Corporation; Subsidiary of TBM Holdings, Inc.
 - b. Fairborn USA Inc.
 - c. Kelley Company, Inc.; a United Dominion Company.
 - d. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
 - e. Rite-Hite Corporation.
 - f. Serco; a United Dominion Company.
- B. Adjustable Head Curtain: Manufacturer's standard hardware and tension spring or counterweight mechanism for adjusting height of pad.
- C. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame. Fabricate jamb and head pads of same depth and sized for opening width.
1. Pressure-Treated Wood Support Frame: Factory painted, with steel mounting hardware.
 2. Steel Support Frame: Steel channel frame of manufacturer's standard weight, shape, and finish, with steel mounting hardware.
 3. Cover Fabric: Vinyl-coated nylon, polyester, neoprene-coated nylon, or Hypalon-coated nylon with minimum total weight of 40 oz./sq. yd.
 5. Guide Strips: 4-inch- wide, coated, nylon guide strips on jamb pads.
 6. Pleated Protectors: Protectors on face of jamb pads of overlapping layers of coated fabric attached to base fabric.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- B. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- C. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
- D. Place self-forming pan system for recessed dock levelers in proper relation to loading platform before pouring concrete.
- E. General: Install loading dock equipment, including safety devices and accessories as required for a complete installation.
 1. Rough-in electrical connections according to requirements specified in Division 16.
- F. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.

1. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
 2. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
 3. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.
- G. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.
- H. Truck Restraints: Attach truck restraints in a manner that complies with requirements for arrangement and height required for device to engage vehicle rear-impact guard. Interconnect control panel and signals with dock leveler.
1. Wall-Mounted Units: Anchor truck restraints to loading dock face with expansion anchors and bolts.
- I. Dock Seals: Attach dock-seal support frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.
- J. Adjust loading dock equipment for proper, safe, efficient operation.
- K. Test dock levelers for vertical travel within operating range indicated.

3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment. Refer to Division 1 Section "Closeout Procedures."

3.3 LOADING DOCK EQUIPMENT SCHEDULE

- A. Steel-Face, Laminated-Tread Bumpers:
1. Thickness: 6 inches
 2. Vertical Style: 11 inches wide by 20 inches high.
- B. Recessed Dock Leveler:
1. Operation: Hydraulic operating system with weatherproof, multibutton remote-control station.
 2. Rated Capacity: 25,000#
 3. Platform Size: 6'-0" x 8'-0".
 4. Vertical Travel: Minimum working range of 12 inches above and 12 inches below adjoining platform.
 5. Length of Lip Extension: 18 inches
 6. Compensation Capacity: Automatic vertical and lateral.

7. Platform: 1/4-inch thick, nonskid steel plate.
8. Hinged Lip: 1/2-inch thick, nonskid steel plate.
9. Frame: Manufacturer's standard type.
10. Toe-Guard Range: Entire upper operating range.
11. Accessories:
 - a. Night locks.
 - b. Interlock to overhead door.
 - c. Interlock to truck restraint.
12. Finish: Painted in manufacturer's standard color.

C. Truck Restraint:

1. Power Operating System: Interlocked to dock leveler, with rear-impact-guard sensor.
2. Communication System: Caution signs and automatic signal lights.
3. Mounting: Wall. Include 2" spacer
4. Accessories:
 - a. Interlock to dock leveler.
 - b. Spacer: Provide 2" cantilever bracket
5. Finish: **Painted in manufacturer's standard color.**

D. Foam-Pad Dock Seal:

1. Beveled Jamb Pads: 12 inches wide at exterior face, tapered to reduce opening width, and sized for opening height.
2. Adjustable Head Pad: 24 inches high and same depth as jamb pads; sized for opening width.
3. Door Opening Size: As indicated on drawings.
4. Cover Fabric: Vinyl-coated nylon or polyester, Neoprene-coated nylon, Hypalon-coated nylon.
 - a. Color: Black
5. Guide Strips: Not required.
6. Pleated Protectors: Not required
7. Support Frame Construction: Pressure-treated wood or Steel.

END OF SECTION 111300

SECTION 122413 - ROLLER SHADES**PART 1 GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SECTION INCLUDES

- A. Manually operated sunscreen roller shades.
- B. Electrically operated double-roller sunscreen and room-darkening shades.

1.4 RELATED SECTIONS

- A. Section 061000 - Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.
- B. Section 092900 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.
- C. Section 095113 - Acoustical Ceilings: Coordination with acoustical ceiling systems for installation of shade pockets, closures and related accessories.
- D. Division 26 - Electrical: Electric service for motor controls.

1.5 REFERENCES

- A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. NFPA 70 - National Electrical Code.
- C. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.

1.6 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Submit Environmental Certification and Third Party Evaluation per Section 1.5 Qualifications.
- C. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 3. Storage and handling requirements and recommendations.
 - 4. Mounting details and installation methods.
 - 5. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.
- D. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
- E. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- F. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
- G. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.
- H. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.
- B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.
- E. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.
- F. Mock-Up: Provide a mock-up (manual shades only) of one roller shade assembly for evaluation of mounting, appearance and accessories.
 - 1. Locate mock-up in window designated by Architect.
 - 2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Store and handle per manufacturer's recommendations.

1.10 WARRANTY

- A. Roller Shade Hardware, Chain and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.

- B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five-year warranty.
- C. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: MechoShade Systems, Inc.; 42-03 35th Street, Long Island City, NY 11101. ASD. Tel: (718) 729-2020. Fax: (718) 729-2941. Email: info@mechoshade.com, www.mechoshade.com.
- B. Requests for substitutions will be considered in accordance with provisions of Division 1.

2.2 APPLICATIONS/SCOPE

- A. Roller Shade Schedule:
 - 1. Shade Type 1: Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings.
 - 2. Shade Type 5: Motorized interior room darkening roller shades with blackout fabric in all exterior windows of rooms and spaces shown on Drawings, and related motor control systems.

2.3 SHADE CLOTH

- A. Visually Transparent Single-Fabric Shadecloth: MechoShade Systems, Inc., ThermoVeil group, single thickness non-raveling 0.030-inch (0.762 mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl, in colors selected from manufacturer's available range.
 - 1. Color: Selected from manufacturer's standard colors.

2.

- B. Room darkening (PVC Free) Shadecloth with opaque acrylic backing: MechoShade Systems, Inc., "Equinox 0100 series", .008 inches thick (.19 mm) blackout material and weighing .94 lbs. per square yard, comprising of 53% fiberglass, 45% acrylic, 2% poly finish.
 - 1. Color: Selected from manufacturer's standard colors.

2.4 SHADE BAND

- A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
 - 1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
 - 2. Shade band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter for manual shades, and less than 2.55 inches (64.77 mm) for motorize shades are not acceptable.
 - b. Provide for positive mechanical engagement with drive / brake mechanism.
 - c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
 - d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
 - e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.5 SHADE FABRICATION

- A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
- B. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shade cloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design. Fabricate hem as follows:
 - 1. Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends
- C. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shade cloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.
- D. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands.
- E. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.
- F. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in an integrally-colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.
 - 1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.
 - 2. Batten pockets shall be self-colored fabric front and back RF welded into the shade cloth. A self-color opaque liner shall be provided front and back to

eliminate any see through of the batten pocket that shall not exceed 1-1/2 inches (38.1 mm) high and be totally opaque. A see-through moiré effect, which occurs with multiple layers of transparent fabrics, shall not be acceptable.

2.6 COMPONENTS

A. Access and Material Requirements:

1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
3. Use only Delrin engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester will not be acceptable.

B. Motorized Shade Hardware and Shade Brackets:

1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.
2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).

C. Manual Operated Chain Drive Hardware and Brackets:

1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.

3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable
7. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
8. Drive Bracket / Brake Assembly:
 - a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
 - b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.
 - c. The brake shall be an over -unning clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.
 - d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
 - e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be

removed and reinstalled without effecting the roller shade limit adjustments.

- D. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.

2.7 SHADE MOTOR DRIVE SYSTEM

A. Shade Motors:

1. Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
2. Conceal motors inside shade roller tube.
3. Maximum current draw for each shade motor of 2.3 amps.
4. Use motors rated at the same nominal speed for all shades in the same room.

- B. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.8 MOTOR CONTROL SYSTEMS

- A. IQ/MLC: Specifications and design of shade motors and motor control system are based on the IQ/MLC motor logic control system manufactured by MechoShade Systems, Inc. Other systems may be acceptable provide that all of the following performance capabilities are provided. Motor logic control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.

1. Motor Control System:

- a. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based motor logic controllers (IQ/MLC).
- b. Control system components shall provide appropriate (spike and brown out) over-current protection (+/- 10 percent of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a recognized component of this system and tested as an integrated system.

- c. Motor control system shall allow each group of four shade motors in any combination to be controlled by each of four local switch ports, with up to fourteen possible "sub-group" combinations via local 3 button wall switches and all at once via a master 3 button switch. System shall allow for overlapping switch combinations from two or more local switches.
 - d. Multiple "sub-groups" from different IQ/MLC control components shall be capable of being combined to form "groups" operated by a single 3 button wall switch, from either the master port or in series from a local switch port.
 - e. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
 - f. Control system shall allow for automatic alignment of shade hem bars in stopped position at 25 percent, 50 percent, and 75 percent of opening heights, and up to three user-defined intermediate stopping positions in addition to all up / all down, regardless of shade height, for a total of five positions. Control system shall allow shades to be stopped at any point in the opening height noting that shades may not be in alignment at these non-defined positions).
 - g. Control system shall have two standard operating modes: Normal mode allowing the shades to be stopped anywhere in the window's opening height and uniform mode, allowing the shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up / all down positioning.
 - h. Control system components shall allow for interface with both audiovisual system components and building fire and life safety system via a dry contact terminal block.
 - i. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, 24 hour timers, and similar items; via a dry contact terminal block.
 - j. Reconfiguration of switch groups shall not require rewiring of the hardwired line voltage motor power supply wiring, or the low voltage control wiring. Reconfiguration of switch groups shall be accomplished within the motor control device (IQ/MLC).
2. Wall Switches:
- a. Three-button architectural flush mounted switches with metal cover plate and no exposed fasteners.

- b. Connect local wall switches to control system components via low voltage (12V DC) 4-conductor modular cable equipped with RJ-11 type connectors supplied, installed and certified under Division 16 - Electrical.
- c. Connect master wall switches to control system components via low voltage (12V DC) 6-conductor modular cable equipped with RJ-12 type connectors supplied, installed and certified under Division 16 - Electrical.

2.9 ACCESSORIES

A. Fascia (for Shade Type 1):

- 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
- 2. Fascia shall be able to be installed across two or more shade bands in one piece.
- 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
- 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
- 5. Notching of Fascia for manual chain shall not be acceptable.

B. Room Darkening Side and / or Sill Channels (for Shade Type 2):

- 1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control and sill light control.
 - a. ElectroShade side channels, 2-1/2 inches (63.5 mm) wide by 1-3/16 inches (30.1 mm) deep; two-band center channels 5 inches (127 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoShade side channels 2-5/8 inches (66.6 mm) may be used as center supports for ElectroShades. Also provide for use with manually operated room darkening MechoShades over 8 feet (2438 mm) in height.
 - b. Color: Dark Bronze

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.
- B. Turn-Key Single-Source Responsibility for Motorized Interior Roller Shades: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and their authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage), shall be provided by the roller shade installer/dealer, in accordance with the requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:
 - 1. Main Contractor shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.
 - 2. Main Contractor shall coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.
 - 3. Roller shade installer/dealer shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by roller shade dealer.

4. Roller shade installer/dealer shall provide and run all line voltage (from the terminating points) to the motor controllers, wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/ control locations designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit, as required by the electrical code having jurisdiction.
 5. Main Contractor shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
 - D. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
 - E. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 122413

SECTION 133419 - Metal Building Systems

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-engineering building, canopy, and components including the following:
 - 1. Structural steel frame.
 - 2. Roof covering system including exterior roof panels, panel attachments, sealants, mastics, trim and flashings.
 - 3. Exterior wall system including wall panels, panel attachments, sealants, mastics, trim and flashings.
 - 4. Metal soffit panels including panel attachments, sealants, mastics, trim and flashing.
 - 5. Thermal Insulation system
 - 6. Accessories
 - 7. Fuel Island (and accessories)

1.2 RELATED SECTIONS

- A. Section 033000 - Cast-in-Place Concrete: Foundations and anchor bolts.
- B. Section 099100 - Paints and Coatings: Finish painting of structural members, doors, roof curbs, and factory prime painted miscellaneous items.

1.3 REFERENCES

- A. AAMA 101 - Voluntary Specification for Aluminum and Poly (Vinyl Chloride) (PVC) Prime Windows and Glass Doors; American Architectural Manufacturers Association.
- B. ASTM A 36/ASTM A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- D. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- E. ASTM A 500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- F. ASTM A 529/A 529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
- G. ASTM A 992 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steel.
- H. ASTM A 607 - Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled.

- I. ASTM A 653/A 653M - Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- J. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- K. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability.
- L. ASTM C 518 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- M. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
- N. ASTM D 1929 - Standard Test Method for Ignition Properties of Plastics.
- O. ASTM D 2843 - Standard Test Method for Smoke from the Burning or Decomposition of Plastics.
- P. ASTM E 72 – Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- Q. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- R. ASTM E 119/E 119-00a – Standard Test Methods for Fire Tests of Building Construction and Materials.
- S. ASTM E 774 - Standard Specification for Sealed Insulating Glass Units.
- T. ASTM E 814 (UL 1471) – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- U. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- V. AWS D1.1 - Structural Welding Code; American Welding Society.
- W. NAIMA 202 - Standard for Flexible Fiber Glass Insulation Used in Metal Buildings; North American Insulation Manufacturers Association.
- X. SDI 100 - Recommended Specifications for Standard Steel Doors and Frames; Steel Door Institute.
- Y. UL 580 - Tests For Wind Uplift Resistance of Roof Assemblies; Underwriters Laboratories Inc.
- Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.
- AA. CAN/ULC S101 – Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.4 DEFINITIONS

- A. Building Width: Measured from outside to outside of sidewall girts.
- B. Building Length: Measured from outside to outside of end wall girts.
- C. Building Line: Outside face of structural steel.
- D. Building Eave Height: Measured from the top of the eave member at the outside of the sidewall girt line to the bottom of the sidewall column base plate.
- E. Bay Spacing: Measured from centerline to centerline of primary frames for interior bays and from centerline of the first interior frame to outside of end wall girts for end bays.
- F. Roof Pitch: The ratio of the vertical rise to the horizontal run.

1.5 SYSTEM DESCRIPTION

- A. General:
 - 1. Provide pre-engineered metal building frame, metal wall panels, metal roof panels, accessories and miscellaneous materials for a complete enclosure including supports for building components specified in other sections.
 - 2. Design structural systems according to professionally recognized methods and standards and legally adopted building codes.
 - 3. Design under supervision of professional engineer licensed in the jurisdiction of the Project.
- B. Design Requirements:
 - 1. Design Loads: As indicated on Structural Drawings and as required by ASCE/SEI 7.
 - 2. Collateral Loads: 5 psf @ Maintenance and Warehouse Buildings; 7 psf @ Material Storage Building
 - 3. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - a) Purlins and Rafters: Vertical deflection of 1/180 of the span.
 - b) Girts: Horizontal deflection of 1/180 of the span.
 - c) Metal Roof Panels: Vertical deflection of 1/180 of the span.
 - d) Metal Wall Panels: Horizontal deflection of 1/180 of the span.
 - e) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 4. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - a) Lateral Drift: Maximum of 1/200 of the building height.
 - b) No drift that would affect adjacent structures.
 - 5. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.

6. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
7. Thermal Movements: 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 joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; material surfaces.

C. Performance Requirements:

1. Provide frame with design roof profile after vertical dead load deflection has occurred.
 2. System to withstand gravity and lateral loads in compliance with contract documents.
 3. Allowable Deflections
 - a. Vertical: Clear span/180 for total load
 - b. Lateral frame movement: Height/200 for a 25 year mean recurrence wind load.
 4. Metal wall panels (interior and exterior) shall not to be used as shear elements.
 5. Construct assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 100 degrees F (37 degrees C).
 6. Design and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.
 7. Thermal Transmission: Testing in accordance with ASTM C 518, "measurement of steady state thermal transmission", the panels shall provide a K-factor of .275 btu/sf/hr/deg. F at 75° F. mean temperature.
- C. Vapor Barrier
1. Air Infiltration: Air infiltration shall not exceed .04 cfm per square foot of wall area when tested per ASTM E 283 at a static pressure of 12.0 psf.
 2. Static Water Penetration: There shall be no uncontrolled water penetration through the panel joints at a static pressure of 20.0 psf when tested per ASTM E 331.
8. Fire:
 1. Surface Burning Characteristics: The insulated core shall have been tested in accordance with ASTM E 84 for surface burning characteristics. The core shall have a maximum flame spread of 0 and a maximum smoke developed rating of 0.

- D. Serviceability Criteria: Deflection limits for major components based on ASCE Buildings standards unless otherwise noted.

1.6 SUBMITTALS

- A. Design Data: Provide signed and sealed detailed design criteria, analysis, and calculations including reactions prepared by a professional licensed structural engineer in state for which work is being performed.
- B. Certification: Manufacturer certification that the building conforms to the contract

documents and manufacturer's standard design procedures.

- C. Shop Drawings: Show building layout, primary and secondary framing member sizes and locations, cross-sections, and product and connection details.
 - 1. Anchor Bolt Installation Drawings: Layouts with minimum bolt diameters.
 - 2. Bracing or portal framed configuration.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square representing actual product, color, and patterns.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 - 1. An IAS Accreditation program AC472.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Erector Qualifications – An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/1.1M, “Structural Welding Code – Steel.”
 - 2. AWS D1.3, “Structural Welding Code – Sheet Steel.”
- D. Structural Steel: Comply with AISC 360, “Specification for Structural Steel Buildings,” for design requirements and allowable stresses.
- E. Cold-Formed Steel: Comply with AISI’s “North American Specification for the Design of Cold-Formed Steel Structural Members” for design requirements and allowable stresses.
- F. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

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 absolute limits.

1.10 WARRANTY

- A. Manufacturer shall warranty installed system for the periods described herein, starting from Date of Substantial Completion against all the conditions indicated below. When notified in writing from Owner, manufacturer/installer shall, promptly and without inconvenience and cost to Owner, correct said deficiencies.
 - 1. Materials and Workmanship Warranty: 3 years.
 - 2. Finish Warranty:
 - a. Finish coating shall not peel, blister, chip, crack or check in finish, and shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D659.
 - b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244.
 - 1) Panel finish: 25 years.
 - 3. Performance Warranty: Furnish written warranty, stating sheet metal roofing system and flashing under this Section will be maintained in watertight condition and defects resulting from the following items will be corrected without cost to Owner for a period of 20 years.
 - a. Faulty workmanship.
 - b. Defective materials including sealants and fasteners.
 - c. Water infiltration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Butler Manufacturing Company; a BlueScope Building, North America, Inc. company.
 - 2. Ceko Building Systems; Division of NCI Building Systems, L.P.
 - 3. Nucor Building Systems.
 - 4. VP Buildings; a BlueScope Building, North America, Inc., company.

2.2 STRUCTURAL STEEL FRAMING

- A. Primary Framing: Rigid Frame (RF Series) solid web framing consisting of tapered or uniform depth rafters rigidly connected to tapered or uniform depth columns. Provide a clear span that supports the loads at bay spacing indicated.
- B. Primary Framing: Continuous Beam (CB Series) solid web framing utilizing tapered or uniform depth beams or girders supported on tapered or uniform depth columns. Locate interior columns where indicated and design to support loads at bay spacing indicated.
- C. End Wall Framing: Corner posts, end posts and rake beams.
- D. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built up steel plates or

structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.

E. Bracing: Provide adjustable wind bracing as follows:

1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 (345); or ASTM A 529/A 529M, Grade 50 (345); minimum 1/2-inch- (13 mm) diameter steel; threaded full length or threaded a minimum of 6 inches (152 mm) at each end.
2. Cable: ASTM A 475, 1/4-inch (6 mm) diameter, extra-high strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

2.3 SECONDARY FRAMING

- A. Purlins & Girts: Zee-shaped; depth as required; with minimum yield strength of 55,000 psi; simple span or continuous span as required for design. All secondary members to be G30 Galvanized.

2.4 ROOF COVERING SYSTEM

- A. Roof Panels: SSR Standing Seam Roof Panels; 24 inches wide net coverage with major ribs formed at the panel side laps, for field seaming using electrically operated seaming machine.
1. Material: Galvalume steel.
 2. Thickness: 24 gage, with 3 inch standing seam.
 3. Side joints: Factory applied sealant for field seaming
 4. Length: Continuous from eave to ridge (no lap joints).
 5. End laps, where required: 6 inches wide, located at a support member.
 6. Panel-to-roof purlin structural attachments: SSR clips, with movable tabs that interlock with seamed SSR panel ribs and provide 1 inch of panel movement in either direction from center of clip to compensate for thermal effects.

2.5 WALL COVERING SYSTEM

- A. Wall Panels: Panel Rib; 36 inch wide net coverage, with 1-3/16 inch high major ribs at 12 inches on center with minor ribs spaced between the major ribs.
1. Material: Galvanized steel, with G90/Z275 coating.
 2. Thickness: 26 gage.
 3. Side laps: Two fully overlapping major ribs secured together with 1/4 inch diameter color-matched carbon steel fasteners.
 4. Length: Continuous from sill to eave (no lap joints).

5. End laps, where required: 4 inches wide, located at a support member.
6. Cut panels square at each end; provide base trim at sill.

B. Liner Panels: Panel Rib Liner Panels: 36 inch wide net coverage, with 1-3/16 inch high major ribs with minor ribs spaced between the major ribs.

1. Material: Galvanized steel, with G90/Z275 coating.
2. Thickness: 28 gage
3. Provide liner panel wainscot to 8 feet nominal.

2.8 DOORS AND FRAMES

A. Hollow Metal Doors and Frames. See Section 081113 and Section 08200

1. Hardware: Access control lockset as specified in Section 087100.
 - a. Balance of hardware refer to hardware schedule in Section 087100.

2.9 WINDOWS AND GLAZING

A. Windows Basis of Design: See Section 084113 and Section 088000

1. Color: Match color called out in Section 084113

2.10 INSULATION

A. Schedule:

1. Roof insulation: (VP Thermalift Insulation)
 1. Blanket insulation - R-value: 29 (combined system, R-16 faced with R-19 unfaced system).
 2. Blanket insulation thermal blocks.
5. Wall Insulation:
 - i. Thermal Design – High-R insulation system - R-value: 22 minimum.
6. Blanket Insulation: Glass fiber, with factory laminated facing material
 1. Glass fiber: Odorless, neutral colored, long filament, flexible resilient, produced in compliance with NAIMA 202.
 2. Flame spread Index: 25 or less, when tested in accordance with UL 723.
 3. Smoke Developed Index: 50 or less, when tested in accordance with UL 723.
 4. UL Classified.
 5. Facing: White polypropylene scrim kraft; 0.0015 inch (0.04 mm) thick polypropylene film, glass fiber scrim reinforcing, 11 lb kraft paper; permeance 0.02 perms (1.1 ng/Pa s sq m). Composite fiberglass and facing meeting Flame Spread of 25 or less, Smoke Developed of 50 or less, when tested in accordance with UL 723.
 6. Provide facing 3 inches (75 mm) wider than blanket on both edges.
 7. Width: As required for installation.

2.11 ROOF ACCESSORIES

A. Eave Gutters: Roll-formed 26 gage steel sheet, with gutter straps, fasteners and joint sealant.

1. Downspouts: 4 by 5 inches in 10 foot lengths, with downspout elbows and downspout straps;

2.12 SNOW RETENTION SYSTEM

- A. Continuous Snow Retention System: Single railtube system clamped to standing seams of metal roof panels.
- B. Basis of Design Product: Subject to compliance with requirements, D-F Dyna-Guard (Dynamic Fastener – 800-821-5448), or comparable product.
- C. Color: Match metal roof panels.
- D. Installation: Per manufacturer's recommendations.
- E. Location: Install above all gutters as shown in drawings.

2.13 FUEL ISLAND

- A. Provide a complete system with all components required for operation of the system.
 1. Fuel island canopy to be 20' wide x 40' long with (2) structural supports with (6) fluorescent lights. (verify specifications with owner).
 2. Clear height of 17'-0" (verify height required with Owner).
 3. Fascia height to be 3'-0"
 4. Roof panels to be 20 ga. min.
 5. Downspouts piped to daylight.
 6. Concrete curb pump island to be 4' wide min. x 25' long min..
 7. Provide 36' wide x 30' long Concrete apron. (36' wide dimension = 16' concrete apron + 4' pump island + 16' concrete apron.) (verify size with Owner). NOTE: If fuel pump island width increases, the overall width of the apron will also increase.
 8. (1) 6,000 gal. double wall above ground gasoline tank (verify size, location, and above/below grade with Owner)
 9. (1) 8,000 gal. double wall above ground diesel tank (verify size, location, and above/below grade with Owner)
 10. Pressurized fuel pump system. (2) Pumps, one per tank, double-sided with card reader activation and tracking system on each side. (verify specifications with owner).
 11. Concrete pad and footing below fuel tanks, designed to meet structural load capacity of tanks with fuel. Concrete pad size to be 5'-0" min. larger than tanks on all sides.
 12. Emergency fuel shut off switch.

13. DEF Fluid dispensing system with built-in heater at pumps.**2.14 MATERIALS**

- A. Structural Steel Plate, Bar, Sheet, and Strip for Use in Bolted and Welded Constructions: ASTM A 572/A 572M, A 529/A 529M, A 1011 or A 36/A 36M Modified 50, with minimum yield strength of 50,000 psi.
- B. Structural Steel Material for Use in Roll Formed or Press Broken Secondary Structural Members: ASTM A 607, with minimum yield strength of 55,000 psi (380 MPa).
- C. Galvanized Steel Sheet for Roll Formed or Press Broken Roof and Wall Coverings, Trim and Flashing: ASTM A 653/A 653M, with minimum yield strength of 50,000 psi..
- D. Galvalume Steel Sheet Used in Roll Formed or Press Broken Roof Covering: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M, with minimum yield strength of 50,000 psi; nominal coating weight of 0.5 oz per sq ft both sides, equivalent to an approximate coating thickness of 0.0018 inch both sides.
- E. Hot Rolled Steel Shapes: W, M and S shapes, angles, rods, channels and other shapes; ASTM A 500, ASTM A 992 or ASTM A 36/A 36M as applicable; with minimum yield strengths required for the design.
- F. Structural Bolts and Nuts Used with Primary Framing: High strength, ASTM A 325.
- G. Bolts and Nuts Used with Secondary Framing Members: ASTM A 307.
- H. Panel Fasteners:
 - 1. For wall panels: Coated carbon steel.
 - 2. Color of exposed fastener heads to match the wall panel finish.
 - 3. Concealed Fasteners: Self-drilling type, of size as required.
 - 4. Provide fasteners in quantities and location as required by the manufacturer.
- I. Flashing and Trim: Match material, finish, and color of adjacent components. Provide trim at rakes, including peak and corner assemblies, high and low eaves, corners, bases, framed openings and as required or specified to provide weathertightness and a finished appearance.
- J. Plastic Parts: Glass fiber reinforced resin or thermoformed ABS (Acrylonitrile-Butadiene-Styrene).
 - 4. ABS: Minimum 1/8 inch thick.
 - 5. Color: Manufacturer's standard color.
- K. Sealants, Mastics and Closures: Manufacturer's standard type.
 - 1. Provide at roof panel end laps, side laps, rake, eave, transitions and accessories as required to provide a weather resistant roof system; use tape mastic or gun grade sealant at side laps and end laps.
 - 2. Provide at wall panel rakes, eaves, transitions and accessories.
 - 3. Closures: Formed to match panel profiles; closed cell elastic material, manufacturer's standard color.
 - 4. Tape mastic: Pre-formed butyl rubber-based, non-hardening, non-corrosive to metal; white or light gray.
 - 5. Gun grade sealant: Non-skinning synthetic Elastomeric based material; gray or

bronze.

2.15 FABRICATION

- A. Fabrication: Fabricate according to manufacturer's standard practice.
 - 1. Fabricate structural members made of welded plate sections by jointing the flanges and webs by continuous automatic submerged arc welding process.
 - 2. Welding operators and processes: Qualified in accordance with AWS D1.1.
 - 3. Field connections: Prepare members for bolted field connection by making punched, drilled, or reamed holes in the shop.
- B. Component Identification: Mark all fabricated parts, either individually or by lot or group, using an identification marking corresponding to the marking shown on the shop drawings, using a method that remains visible after shop painting.

2.16 FINISH

- A. Schedule of Finishes:
 - 1. Roof finish and color: As selected by Architect from manufacturer's full range of colors.
 - 2. Wall finish and color: As selected by Architect from manufacturer's full range of colors.
 - 3. Liner panel finish and color: Siliconized modified polyester – Cool Cotton White
 - 4. Soffit panels finish and color: As selected by Architect from manufacturer's full range of colors.
 - 5. Trim, cutters, and downspout finish and color: Match wall panels.
- B. Shop Coat: Manufacturer's standard rust inhibitive primer paint; manufacturer's standard color.
 - 1. Finish all structural steel members using one coat of manufacturer's standard shop coat, after cleaning of oil, dirt, loose scale and foreign matter.
- C. KXL Pre-Painted Finish: 1 mil Kynar 500 coating on exterior surface.
 - 1. Color: Interior Finish: Off white 0.5 mil washcoat.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Verify foundations are properly installed, to correct dimensions and within acceptable tolerances.
 - 2. Verify location of covered or built-in work.
 - 3. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Framing Erection: Erect framing in compliance with AISC Specification.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent

bracing. Locate braced bays as required by manufacturer.

3.3 ERECTION OF FRAME

- A. Install in accordance with manufacturer's instructions.
- B. Do not erect frames without complete installation of tie beams and anchorages.
- C. Set column base plates with non-shrink grout to full plate bearing.
- D. Do not field cut or alter structural members without written approval.
- E. After erection, prime bolts, welds, abrasions, and surfaces not primed with primer used in shop painting.

3.4 INSTALLATION OF WALL AND ROOF SYSTEM

- A. Install in compliance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End lap panels according to manufacturer's recommendations. Place sidelaps over bearing.
- E. Provide expansion joints where indicated or required by manufacturer.
- F. Use concealed fasteners.
- G. Install sealant and gaskets to prevent weather penetration.
- H. Install system free of rattles, noise due to thermal movement, and wind whistles.
- I. Install door frames, service doors, overhead doors, window and glass, and gutter system in compliance with manufacturer's instructions.
- J. Seal wall and roof accessories watertight and weathertight with sealant in compliance with building manufacturer's standard procedures.
- K. Rigidly support and secure gutters and downspouts. Joint lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- L. Apply bituminous paint on surfaces in contact with cementitious materials.
- M. Tolerances:
 - 1. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
 - 2. Racking: 1/8 inch from true position. Provide shoring to maintain position prior to cladding installation.

3.5 FIELD QUALITY CONTROL

- A. Testing by Contractor:

1. Roof installation inspection by roof manufacturer's representative; as required as part of warranty provision.
- B. Testing by Owner:
 1. High Strength Bolted Connections: Specification for Structural Joints Using ASTM A325 or A490 Bolts, with minimum testing of bolted connections per the arbitration inspection procedure.
 2. Welded Connections: AWS. Visual inspection of 100 percent of welds. Ultrasonic inspection of 50 percent of full and partial penetration welds. A rejection rate greater than 5 percent will increase the inspection to 100 percent.
 3. General Testing: For materials and installed tolerances.

END OF SECTION

SECTION 323113 - CHAIN-LINK FENCES AND GATES**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Chain-Link Fences: Industrial
 - 2. Gates: Motor operated horizontal slide
- B. See Division 16 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
 - 1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
- C. Samples:
 - 1. Aluminized steel wire for fabric.
- D. Maintenance Data: For gate operator

1.5 QUALITY ASSURANCE

- A. 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.
- B. UL Standard: Provide gate operators that comply with UL 325.
- C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Height indicated on Civil Drawings for exterior fencing, on architectural drawings for interior fencing. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
 - 1. Steel Wire Fabric: The fence shall consist of number 9 USWG steel wire having a minimum breaking strength of 1,200 lbs. and it shall be woven into a 2 in. square mesh. The sides of the mesh pattern shall be approximately 45° to a vertical line. The fabric shall be galvanized after weaving in accordance with ASTM A392, Class II.
 - a. Coating: All galvanizing to withstand six one-minute immersions in copper sulphate per ASTM "Standard Method of Test for Uniformity of Coating by the Preece Test (Copper Sulphate Dip) on Zinc-Coated (Galvanized) Iron or Steel Articles: A239. All welding to be performed before galvanizing is applied.
 - 2. Selvage: Knuckled at both selvages

2.2 INDUSTRIAL FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:
 - 1. Line Posts
 - a. Hot dipped galvanized steel pipe, 2 1/2" O.D., weighing 3.65 lb/ft with a wall thickness of .154" and galvanized in accordance with specification ASTM A120.
 - b. Alternate: 2 1/2" O.D. SS40 – 3.12 lb/ft.
 - c. Tubular material shall conform to ASTM A53 Grade B and roll-formed material shall meet the yield stress requirements of ASTM A36.
 - d. Height: Sufficient to extend 3 feet into footings.

- e. Spacing: Posts to be evenly spaced in the fence line no further apart than 10 feet centers.
- 2. Corner Posts
 - a. Materials: Hot dipped galvanized steel pipe, 4" O.D., weighing 5.79 lb/ft with a wall thickness of .203 and galvanized in accordance with specification ASTM A120.
 - b. Alternate: 4" O.D. SS40 - 6.56 lb/ft..
- 3. End/Gate/Pull Posts
 - a. Materials: Hot dipped galvanized steel pipe, 4" O.D., weighing 5.79 lb/ft with a wall thickness of .203 and galvanized in accordance with specification ASTM A120.
 - b. Alternate: 4" O.D. SS40 - 6.56 lb/ft..
- 4. Top Rail
 - a. Materials: Hot dipped galvanized steel pipe, 1 5/8" O.D., weighing 2.27 lb/ft with a wall thickness of .138" and galvanized in accordance with specification ASTM A120.
 - b. Alternate: 1 5/8" O.D. SS40 – 1.84lb/ft.
 - c. Couplings: Outside sleeve type, spaced about 20 ft. apart, at least 5 ½ inches long, with provisions for expansion and contraction, hot-dipped galvanized per ASTM A123.
- 5. Fastenings: Top rail to pass through base of extension arm and to be securely fastened to end, gate, and pull posts.

2.3 POST BRACES

- 1. Post braces are required at each gate, corner, pull, and end post. It shall consist of a strut, which shall not be less in size than the top rail, and a tension rod with turnbuckle. The rod shall be steel and have a minimum diameter of 3/8".
- 2. The strut shall be secured to the adjacent line post at approximately mid-height of the fabric. The tension rod is also secured near this area on the line post and is anchored near the base of the corner-gate pull or end post.
- 3. Bracing members shall all be hot-dipped galvanized per ASTM A153.

2.4 STRETCHER BAR

- 1. Material: Hot dipped galvanized steel bars not less than ¼" x ¾". Length shall be approximately 1" less than fabric height.
- 2. General: The stretcher bar shall be used for securing the fabric to all terminal posts. One bar is required for each gate and end posts and two are required for each corner and pull posts.

2.5 TENSION WIRE

- A. Materials: Tension wires shall not be less than number 7 USWG galvanized steel wire.

2.6 INDUSTRIAL DRIVE-IN GATES

- A. General: Comply with ASTM F 1184 for double slide gate types.
 - 1. Classification: Type II Cantilever Slide, Class 2 with internal roller assemblies.
 - 2. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1184 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from square galvanized steel (alternate: rectangular aluminum) tubing with outside dimension and weight according to ASTM F 1184 and the following:
 - 1. Gate Fabric Height: As indicated on civil drawings.
 - 2. Gate Opening Width: As indicated on civil drawings.
 - 3. Frame Members:
 - a. Tubular Steel: 1.90 inches round
 - b. Alternate: rectangular aluminum.
 - 4. Bracing Members:
 - a. Tubular Steel: 1.66 inches round
 - b. Alternate: rectangular aluminum.
- C. Frame Corner Construction:
 - 1. Welded frame with panels assembled with bolted or riveted corner fittings and 5/16-inch-diameter, adjustable truss rods for panels 5 feet wide or wider.
- D. Hardware: Latches permitting operation from both sides of gate, locking devised, roller assemblies, and stops fabricated from galvanized steel.
- E. Gates with operators must comply with ASTM F2200.

2.7 INDUSTRIAL SWING GATES (at Man gates)

- A. General: Comply with ASTM F 900 for swing gate types.
 - 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:
 - 1. Gate Fabric Height: Match adjacent fencing.

2. Leaf Width: As indicated on drawings.
3. Frame Members:

- a. Tubular Steel 1.90 inches round

C. Frame Corner Construction:

1. Welded and 5/16-inch diameter, adjustable truss rods for panels 5 feet wide or wider.

D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame as required to match adjacent fence height to attach barbed wire assemblies.

E. Hardware: Latches permitting operation from both sides of gate, hinges. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

1. Gate lock & latch Basis of Design: D&D Technologies LokkLatch Rouch Gate Latch with External Access Kit, Key Lockable
2. Hinges Basis of Design: D&D Technologies TruClose Mini Multi-Adjust Gate Ginge for Round Posts, Adjustable Tension

2.8 FITTINGS

A. General: Comply with ASTM F 626.

B. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

2.9 BARBED WIRE (Exterior Fencing only)

A. Material: Three strands of No. 12 ½ USWG steel wire with a minimum aluminum coating weight of not less than 0.30 ounces per square foot of wire surface, 4 half-round barbs of No. 14 steel wire gauge spaced 5” apart, all per ASTM A121, Class 3 “Standard Specifications for Aluminum-Coated, Zinc-Coated (Galvanized) Iron or Steel Barbed Wire.”

B. Number of Lines: Three

C. Each line shall be terminated at each corner or gate post.

2.10 GATE OPERATORS

A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

B. Comply with NFPA 70.

- C. Motor Characteristics: Provide Liftmaster CSW24UL or approved equal, sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG-1 and the following:
 - 1. Voltage: **120 V**, 20 A
 - 2. Horsepower: ½ HP min., or as required for gate size.
 - 3. Heater Kit: Self-regulating, thermostatically controlled.
 - a. Provide adequate circuit to accommodate heater and motor.
- D. Gate Operators: Concrete base/pad mounted and as follows:
 - 1. Mechanical Gate Operators (as indicated on civil drawings):
 - a. Duty: Heavy-duty, commercial/industrial.
- E. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with enclosure and with space for additional optional equipment. Provide card reader and/or digital keypad station remote-control device(s).
 - 1. Coordinate with access control system and owner.
- F. Radio Control: Digital system consisting of code-compatible universal receiver with transmitter.
 - 1. Coordinate with access control system and owner.
- G. Telephone Entry System: Hands-free voice-communication system for connection to building telephone system with digital-entry code activation of gate operator and auxiliary keypad entry
- H. Vehicle Detector: Loop and detector saw cut system including automatic closing timer with adjustable time delay before closing; designed to open and close gate and hold gate open until traffic clears. Loop system to be installed a minimum of 12' away from the gate.
- I. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately reverse gate in both opening and closing cycles and hold until clear of obstruction.
 - 1. Provide photo eye EMX IRB4 with hoods or MilleEdge Sensing Edge, or approved equal (verify with owner prior to installation)
- J. Accessories:
 - 1. Emergency Power: provide additional contacts if required for connection to owner's emergency generator.
 - 2. Battery Backup System: Provide integral battery backup using two (2) 7-AH batteries to provide 24-days of standby power in even of power loss and 208 gate cycle. Power manager system draws 14.8 mA when gate is idle with remote controls programmed.
 - 3. Intercom System: coordinate with access control system.
 - 4. Instructional, Safety, and Warning Labels and Signs: According to UL 325

2.11 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water.
 - 1. Concrete Mixes: Normal-weight concrete with not less than 4000-psi compressive strength (28 days), 3-inch slump, and 1-inch (maximum size aggregate).

2.12 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Comply with UL 467.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
- D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.
- E. Line Posts: Space line posts uniformly at 10 feet o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F 567. Install braces at end and gate posts and at both sides of corner and pull posts.
- G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing.
- H. Top Rail: Install according to ASTM F 567.
- I. Bottom Rails: Install, spanning between posts.

- J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated.
- K. Tie Wires: Attach wire per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- M. Barbed Wire: Uniformly spaced, angled toward security side of fence. Pull wire taut and install securely to extension arms and secure to end post or terminal arms.

3.2 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.3 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Concrete Bases/Pads: Cast-in-place or precast concrete, 6 to 12 inches below frost line dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.
- C. Vehicle Pressure Plate Detector System (for use as vehicle detection): install under pavement according to manufacturer's written instructions. Connect to equipment operated by detector
- D. Vehicle Loop Detector System (for use as obstruction detection): Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.4 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet
- B. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - 1. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location.

- C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
 - 1. Connections: Make connections so possibility of galvanic action or electrolysis is minimized.
- D. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.5 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Owner may engage a qualified independent testing agency to perform field quality-control testing.

END OF SECTION 323113

SECTION 323119 – ORNAMENTAL METAL FENCING SYSTEM AND CANTILEVER GATES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Ornamental Fences
 - 2. Gates: Motor operated, horizontal slide.
- B. See Division 16 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

1.2 RELATED WORK

- A. Division 3 – Cast-in-Place Concrete
- B. Division 31 – Earthwork

1.3 RELATED DOCUMENTS

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

1.3 SYSTEM DESCRIPTION

- A. The manufacturer shall supply a total ornamental metal fencing system of the design, style, strength and picket interspace defined herein. The system shall include all components (i.e., pickets, rails, posts, gates and hardware) required.
- B. The manufacturer shall supply a total cantilever gate system of the design, style, and picket interspace defined herein. The system shall include all components (i.e., framework, fabric attachment fasteners, and hardware) required.

1.4 QUALITY ASSURANCE

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.
- B. 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.
- C. UL Standard: Provide gate operators that comply with UL 325.

1.5 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.6 SUBMITTAL

- A. The manufacturer's literature shall be submitted prior to installation.
- B. Fence and gate drawings including plan, elevations, details, electrical requirements, etc.
- C. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
 - 1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 2. Any additional grounding requirements due to the Overhead Transmission lines at the north end of the property. Fencing contractor to contact Owner of the lines to determine if any additional grounding is required.
- D. Maintenance Data: For gate operator.

1.7 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

PART 2 - PRODUCTS

2.1 FENCE

- A. Manufacturer: The commercial ornamental steel fence system shall conform to Ameristar Aegis II, Ornamental Steel, Classic Design, extended picket bottom rail treatment, 3-Rail style manufactured by Ameristar Fence Products, Inc. in Tulsa, Oklahoma.
- B. Height: 8'-0" (nom).
- C. Color: black
- D. Material:
 - 1. Steel material for fence framework (i.e., tubular pickets, rails and posts), when galvanized after forming, shall conform to the requirements of ASTM A1011/A1011M, with a minimum yield strength of 45,000psi. The exterior shall be hot-dip galvanized with a 0.90oz/ft² minimum zinc weight. The interior surface shall be coated with a minimum of 81% nominal zinc pigmented coating, 0.2mils minimum thickness.
 - 2. Steel material for fence framework (i.e., tubular pickets, rails and posts), when galvanized prior to forming, shall conform to the requirements of ASTM A924, with a minimum yield strength of 45,000psi. The steel shall be hot-dip galvanized to meet the requirements of ASTM A653 with a minimum zinc coating weight of 0.90oz/ft², Coating Designation G-90.
 - 3. Galvanized framework shall be subject to six-stage pretreatment/wash (with zinc phosphate) followed by an electrostatic spray application of a two-coat powder system. The base coat is a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2-4mils. The top coat is a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2-4mils. The color shall be black. Coated galvanized framework shall be a salt spray resistance of 3,500 hours using Test Method B117 without loss of adhesion.
 - 4. Material for pickets shall be 1" square x 14 ga. Tubing. The rails shall be steel channel, 1.75" x 1.75". Picket holes in the rail shall be spaced 4.715" o.c. For fence systems up to and including 6 feet tall, posts shall be a minimum of 2-1/2" square x 12 Ga. For fence systems 7 feet tall and 8' tall, posts shall be a minimum of 3" square x 12 ga. Gate posts shall meet the minimum requirements of Table 1.
 - 5. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
 - 6. The manufactured panels shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be (specify Black). The coated panels shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.
- E. Fabrication:

1. Pickets, rails and posts shall be precut to specified lengths. ForerunnerTM rails shall be pre-punched to accept pickets.

2.2 CANTILEVER GATE

- A. Manufacturer: The cantilever gate system shall conform to Ameristar Aegis IITM ornamental picket design, Classic, (3)-Rail style, full width of opening. 8 feet height, with 4" square posts.
- B. Material Requirements:
 1. The materials used for cantilever gate framing shall be manufactured from aluminum (designation 6063-T6, see ASTM B-221) with a maximum yield strength of 25,000psi, a maximum tensile strength of 30,000psi and a standard mill finish. The top rail shall be manufactured from Aluminum (designation 6063-T6) with a yield strength of 35,000psi, a tensile strength of 38,000psi and a standard mill finish.
 2. Frame shall be pre-punched to accept 1" square ornamental pickets (designation 6063-T6, see ASTM B-221).
 3. Counter supports shall be braced with either truss cables or brace framing.
 4. Two upper suspension rollers and two lower guide rollers shall be included with each gate.
 5. In order to meet ASTM F2200, an expanded metal sheet (powder coated to match gate finish) must be installed on the inside face at each gate leaf, full height and including any back frame or counterbalance portion, to prevent a 2 ¼" sphere from passing through the openings anywhere in the gate.
- C. Fabrication:
 1. Components shall be precut to specified lengths.
 2. Completed framing components shall be tested for alignment and fit at the factory prior to shipping.

2.3 GATE OPERATORS

- A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.
- B. Comply with NFPA 70.
- C. Motor Characteristics: Provide Liftmaster CSL24VDC or approved equal, sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Include internal entrapment device in operator. Comply with NEMA MG-1 and the following:
 1. Voltage: 120 V, 20A.
 2. Horsepower: ½ HP min., or as required by gate size.
 3. Heater Kit: Self-regulating, thermostatically controlled.
 - a. Provide adequate circuit to accommodate heater and motor.
- D. Gate Operators: Concrete base/pad mounted and as follows:

1. Mechanical Slide Gate Operators:
 - a. Duty: Heavy-duty, commercial/industrial.
- E. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with enclosure and with space for additional optional equipment. Provide digital keypad station remote-control device(s).
 1. Coordinate with access control system and Owner.
- F. Radio Control: Digital system consisting of code-compatible universal receiver with transmitter.
 1. Coordinate with access control system and Owner.
- G. Vehicle Detector: Loop and detector saw cut system including automatic closing timer with adjustable time delay before closing; designed to open and close gate and hold gate open until traffic clears. Loop system to be installed a minimum of 12' away from the gate.
- H. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately reverse gate in both opening and closing cycles and hold until clear of obstruction.
 1. Photo eye – EMX IRB4 with hoods OR MillerEdge Sensing Edge. (VERIFY WITH OWNER)
- I. Accessories:
 1. Emergency Power: Provide additional contacts if required for connection to Owner's emergency generator.
 2. Intercom System: Coordinate with access control system.
 3. Instructional, Safety, and Warning Labels and Signs: According to UL 325.

EXECUTION

2.2 PREPARATION

1. All new installation shall be laid out by the contractor in accordance with the construction plans.

2.3 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 42" – verify with manufacturer recommendations. The "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

2.4 GATE INSTALLATION

- A. Set gate post(s) in accordance with the gate elevation drawings.

- B. Attach upper suspension rollers to gate post(s) per end view (cross-section) in construction drawings; slide Transport^s top rail onto rollers.
- C. Install lower guide rollers and gate stops.

2.5 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Concrete Bases/Pads: Cast-in-place or precast concrete, depth not less than 12" below frost line or detail on Drawings, dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.
- C. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

2.6 CLEANING

- A. The contractor shall clean the jobsite of excess materials. Post hole excavations shall be removed.

Table 1 – Minimum Sizes for Aegis II Posts			
<u>Fence Posts</u>	<u>Panel Height</u>		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' & Including 10' Height		
<u>Gate Leaf</u>	<u>Gate Height</u>		
	<u>Up to & Including 6'</u>	<u>Over 6' Up to & Including 8'</u>	<u>Over 8' Up to & Including 10'</u>
Up to 4'	3" x 12 Ga.	3" x 12 Ga.	4" x 11 Ga.
4'1" to 6'	3" x 12 Ga.	3" x 12 Ga.	4" x 11 Ga.
6'1" to 8'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	6" x 3/16 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 16'	6" x 3/16 Ga.	6" x 3/16"	8" x 1/4"

Table 2 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).

Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – AEGIS II – Post Spacing By Bracket Type										
Span	For INVINCIBLE® 8' / 6' Nominal (91-1/4" / 71-3/8" Rail)				For CLASSIC, GENESIS, & MAJESTIC (92-5/8" / 67-3/4" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301SR)*		Industrial Line 2-1/2" (BB319SR) 3" (BB320SR)		Industrial Universal 2-1/2" (BB302SR) 3" (BB303SR)		Industrial Flat Mount (BB301SR)		Industrial Swivel (BB304SR)*	
Post Settings ± 1/2" O.C.	94-1/2" / 75"	95" / 75-1/2"	94-1/2" / 75"	95" / 75-1/2"	96" / 71-1/2"	96-1/2" / 72"	96" / 71-1/2"	96-1/2" / 72"	*96" / 71-1/2"	*96-1/2" / 72"

*When using BB304SR swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel.

END OF SECTION 328250

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DIVISION 03 – CONCRETE

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SECTION 033000 - CAST-IN-PLACE CONCRETE**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
 - 1. Footings
 - 2. Foundation walls
 - 3. Slab on grade
 - 4. Elevated floor slabs
 - 5. Exterior sidewalks, ramps and platforms
- B. Related items specified elsewhere:
 - 1. Section 079200 "Joint sealants"
 - 2. Section 071700 "Bentonite Waterproofing"
 - 3. Section 312000 "Earthwork"

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
 - 1. All design mixtures shall be submitted with historical data showing concrete compressive strength test data of each mix design submitted.
- C. Shop Drawings:
 - 1. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. 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.
 - 2. Control/construction joint pattern layout.
- D. Material test reports.

1. Aggregates
- E. Material Certificates:
 1. Cementitious materials
 2. Admixtures
 3. Steel reinforcing accessories
 4. Curing compounds
 5. Floor slab and treatment
 6. Vapor barriers
 7. Sealer/Dustproofer
- F. Field Quality – control test reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel conducting laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 1. ACI 301, "Specification for Structural Concrete,"
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. AASHTO T318 - Measurement of Water Content of Fresh Concrete Using the Microwave Oven.
- E. Preinstallation Conference: Conduct conference at Project 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 117

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints. Class 1 or better.
- 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. Chamfer Strips: Wood, metal, PVC, or rubber strips, $\frac{3}{4}$ " x $\frac{3}{4}$ " minimum.
- D. Form Release Agent: Commercially formulated agent that will not bond with, stain, or adversely affect surface and will not impair subsequent treatments of surfaces.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes not 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.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- C. 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, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."
- D. Joint Dowel Bars: ASTM A615/A615M, Grade 60

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I or II.

2. Fly Ash: ASTM C 618, Class F Maximum of 25% may be used. Minimum of 20 % shall be used (where permitted)
 3. Blended Hydraulic Cement: ASTM C-595 Type IL, Portland Limestone Cement
- B. Normal-Weight Aggregates: ASTM C 33, graded, coarse-aggregate.
1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 2. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.
 3. Chloride Ion Level: Chloride ion content of aggregate shall be tested by the laboratory making the trial mixes. The total chloride ion content of the mix including all constituents shall not exceed the limitations set forth in ACI 318 for concrete subjected to deicers or exposed to chloride in service (0.15 chloride ions by weight of cement).
- C. Water: ASTM C 94/C 94M and potable.
- D. Air-Entraining Admixture: ASTM C 260.
1. Products
 - a. Euclid Chemical Company: Eucon Air Mix or-AEA-92 Series.
 - b. GCP Applied Technologies: Darex or Daravair Series.
 - c. Master Builders: MasterAir AE 90 or AE 400
 - d. Or approved equal
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - a. Products
 - 1) Euclid Chemical Company: Eucon WR
 - 2) Master Builders: MasterPozzolith Series
 - 3) Chryso Saint- Gobain: Zyla Series
 - 4) Or approved equal
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - a. Products
 - 1) Euclid Chemical Company: Eucon Series
 - 2) Master Builders: Pozzolith Series
 - 3) Chryso Saint- Gobain: Zyla Series
 - 4) Or approved equal
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

- a. Products
 - 1) Euclid Chemical Company: Eucon Series
 - 2) Master Builders: MasterPozzoloth Series
 - 3) Chryso Saint- Gobain: Zyla Series
 - 4) Or approved equal
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - a. Products
 - 1) Euclid Chemical Company: Eucon 37 or Plastol Series
 - 2) Master Builders: MasterRheobuild 1000 or MasterGlenium Series
 - 3) Chryso Saint- Gobain: Adva series
 - 4) Or approved equal
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - a. Products
 - 1) Euclid Chemical Company: Eucon 537 or Plastol Series
 - 2) Master Builders: MasterGlenium Series
 - 3) Chryso Saint- Gobain: Adva series
 - 4) Or approved equal
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 - a. Products
 - 1) Euclid Chemical Company: Eucon 537
 - 2) Master Builders: MasterRheobuild Series
 - 3) Chryso Saint- Gobain: Adva Series
 - 4) Or approved equal
- F. Viscosity Modifying Admixture (VMA): Liquid admixture used to optimize viscosity of Self-Consolidating Concrete (SCC). Products: Subject to compliance with requirements, provide the following at dosage rates per manufacturer's recommendation:
 1. Products
 - a. Euclid Chemical Company: Viscetrol.
 - b. Master Builders: MasterMatrix VMA Series.
 - c. Or approved equal
- G. Non-Chloride, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Provide the following:
 - a. Euclid Chemical Company: Accelguard 80, 90 or NCA .
 - b. Master Builders: MasterSet AC 534 or MasterSet FP 20
 - c. Chryso Saint- Gobain: Daraset

- d. Or approved equal
- H. Alkali-Silica Reactivity Inhibitor: A specially formulated lithium nitrate admixture for the prevention of alkali-silica reactivity (ASR) in concrete. The admixture must have test data indicating conformance to ASTM C1293.
 - 1. Products
 - a. Euclid Chemical Company: Eucon Integral ARC.
 - I. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Engineer.

2.5 VAPOR BARRIERS

- A. Plastic Vapor Barrier: ASTM E 1745 Class A (Plastics) vapor barrier, not less than 15 mils thick. Permeance as tested after mandatory conditioning equal to or less than 0.01 perms as tested by ASTM E96 or ASTM F 1249. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
 - 1. Basis of Design:
 - a. Stego Wrap Vapor Barrier by STEGO INDUSTRIES LLC
 - 2. Other acceptable products:
 - a. Griffolyn by Reef Industries
 - b. VaporBlock 15 by Viaflex
 - c. Or approved equal

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- 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, dissipating.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751. asphalt-saturated cellulosic fiber with removeable “zip strip” edge for installation of sealant.
- B. Semi-rigid Joint Filler: Two component, semi-rigid, 100 percent solids, with a minimum shore A hardness of 80 per ASTM D 2240.
 - 1. Products:
 - a. Metzger McGuire Corp.; MM-80
 - b. Euclid Chemical Company; Euco 700
- C. Sealer / Dustproofers: Water – based sodium solution, 0g/L VOC content. Provide one of the following or approved equal.
 - 1. Euclid Chemical Company: Eucosil
 - 2. Master Builders: MasterKure HD 200WB
- D. Bentonite Waterstop: 75% sodium bentonite and 25% butyl-rubber composite.
 - 1. Products:
 - a. Minerals Technologies Inc (CETCO): Waterstop-RX
 - b. Or approved equivalent.

2.8 SURFACE REPAIR MATERIALS

- A. Admixture Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 - 1. Products:
 - a. Euclid Chemical Company: Flexcon or Akkro 7T.
 - b. Chryso Saint- Gobain: Daraweld C.
- B. Epoxy Bonding Adhesive: ASTM C 881, 100% solids, 100% reactive compounds, 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. Designated repairs shall be made, with prior approval of the Engineer, as to method and procedure, using these epoxy adhesives and/or epoxy mortar. Where epoxy injection procedures must be used, an approved low viscosity epoxy made by these manufacturers shall be used.
 - 1. Products:
 - a. Euclid Chemical Company: Dural series.
 - b. GCP Applied Technologies: Silcor
- C. Extended Open Time Epoxy Bonding Agent: Three component, water based, epoxy modified portland cement bonding agent and anti-corrosion protection coating providing up to 24 hours open time in which to apply repair mortar. Product shall be capable of achieving bond strength of 2,700 psi per ASTM C 882.

1. Products
 - a. Euclid Chemical Company: Duralprep AC.
- D. Surface Patching Mortar: Polymer modified, cementitious repair mortar achieving 3-day minimum compressive strength of 3,000 psi and 28-day minimum compressive strength of 5,000 psi, per ASTM C 109.
 - a. Euclid Chemical Company: Tamms Thin Patch, Speed Crete Red Line or Speed Crete PM.
 - b. Master Builders: MasterEmaco series
- E. Repair Underlayment: Portland Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, 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 (3.2 to 6 mm) 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.
 5. Products:
 - a. Euclid Chemical Company: Super Flo-Top.
 - b. Ardex Engineered Cements; Ardex K15.
- F. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, 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 (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.
 5. Products:
 - a. Euclid Chemical Company: Tammspatch II.
 - b. Ardex Engineered Cements: Ardex K500.

2.9 GROUTS

- A. Non-shrink Grout: Conforming to ASTM C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink). Premixed compound consisting of non-metallic

aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7000 psi in 28 days;

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company: NS Grout.
 - b. Sika: SikaGrout-928
 - c. Five Star Products: NSG Grout
 - d. Or approved equal

2.10 LIQUID FLOOR TREATMENTS

- A. Penetrating Densifier and Dustproofers (All slabs other than Maintenance Building): Water-based reactive silicate solution, 0 g/L VOC content. Designed to penetrate harden and densify concrete surfaces. Provide one of the following or approved equal.

1. Euclid Chemical Company: Eucosil
2. Master Builders: MasterKure HD 200 WB
3. Ashford Formula: Cure Crete

- B. Liquid Densifier/Sealer (Maintenance Building): High performance, deeply penetrating concrete densifier/sealer; odorless, colorless, VOC - compliant, non-yellowing silicate/siliconate blend solution designed to harden, dustproof and protect concrete floors and to resist black rubber tire marks. The compound must contain a minimum solids/reactive content of 20% of which 50% is siliconate.

1. Products

- a. Euclid Chemical Company: Euco Diamond Hard.
- b. TK Products: TK - 5329

2.11 CONCRETE MIXTURES, GENERAL

- A. Water/Cementitious Ratio:

1. All concrete subject to freezing and thawing shall have a maximum water/cementitious ratio of 0.45 (4500 psi at 28 days or more).
2. All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cementitious ratio of 0.40 (5000 psi at 28 days or more).
3. All trowel finished interior slabs, subjected to vehicular traffic, shall have a maximum w/c ratio of 0.45.

- B. Air Content:

1. All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%.
2. All interior slabs and all slabs to receive dry-shake shall have a maximum air content of 3%.

- C. Slump:

1. All concrete containing the high-range water-reducing admixture (superplasticizer) shall have a maximum slump of 9" unless otherwise approved by the Structural Engineer. The concrete shall arrive at the job site at a slump of 2" to 3", (3" to 4" for concrete receiving a dry-shake hardener), be verified, then the high-range water-reducing admixture added to increase the slump to the approved level.
 2. All other concrete shall have a maximum slump of 5."
- D. 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 independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- E. Cementitious Materials:
1. Fly Ash: 25 percent, maximum.
 2. Combined Fly Ash and Pozzolan: 25 percent.
- F. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or high-range water reducing 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 high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, fiber reinforced concrete, and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use non-corrosive accelerator for all concrete, less than 8 inches thick, placed at air temperatures below 50 degrees Fahrenheit.
 5. Use high range water reducing admixture and viscosity modifying admixture, where required, in Self-Consolidating Concrete (SCC).
 6. Use shrinkage reducing admixture where indicated on drawings to keep shrinkage below 0.04%.
 7. Use alkali-silica reactivity inhibitor unless ready mix company confirms that the aggregates to be used on the job are non-reactive.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4500 psi at 28 days.
 2. Minimum Portland Cement Content: 470 lbs per cubic yard.
 3. Maximum Water-Cementitious Materials Ratio: 0.45.
 4. Slump Limit: 5 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 5. Air Content: 6% +/- 1.5%.
 6. Fly Ash: 20 % minimum.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Minimum Portland Cement Content: 470 lbs per cubic yard.
3. Maximum Water-Cementitious Materials Ratio: 0.45.
4. Slump Limit: 5 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
5. Air Content: 6% +/- 1.5%.
6. Fly Ash: 20 % minimum.

C. Interior Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.48.
3. Slump Limit: 4 inches, plus or minus 1 inch. 9 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture (3" to 4" for concrete receiving a dry-shake hardener).
4. Air Content: None.
5. Fly Ash: Permitted.

D. Exterior Slabs: Proportion mixes to provide concrete with the following properties.

1. Minimum Compressive Strength: 4,000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches.
4. Air Content: 4 to 8 percent at point of placement.
5. Fly Ash: Not permitted.

E. Suspended Slabs: Normal weight concrete.

1. Minimum Compressive Strength: As indicated on structural drawings at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.48
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.

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.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..

3. 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.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete as shown on drawings.

3.2 EMBEDDED ITEMS

- 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. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 VAPOR BARRIER

- A. Plastic Vapor Barriers: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions. Vapor Barriers shall be a minimum thickness of 15mil unless noted otherwise.
 1. Lap Vapor Barrier over footings and seal to foundation walls.
 2. Overlap joints 6 inches and seal with manufacturer's tape.
 3. Seal all penetrations (including pipes) per manufacturer's instructions.
 4. No penetration of the Vapor Barrier is allowed except for reinforcing steel and permanent utilities.
 5. Repair damaged areas by cutting patches of Vapor Barrier, overlapping damaged area 6 inches and taping all four sides with tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing 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 would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- 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.

3.5 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.
- 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: A Soff Cut saw shall be used to cut control joints to a depth of 1 ¼ inches immediately after final finishing. when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks. A conventional saw shall be used as soon as possible after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks to a depth of ¼ slab thickness or 1/3 slab thickness if steel-fiber or structural synthetic macro fiber reinforcement is used.
 - 2. Saw cut plan must be submitted and approved by the Engineer
- 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.
- 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.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be 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.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 305.1.

3.7 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, or to be covered with a coating or covering material applied directly to concrete.
- 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 one part portland cement to one and one-half 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 will match 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.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- 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.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen 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 surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch.
- C. 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 thin-set 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.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, vehicle storage areas (including all covered vehicle storage areas), 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.
- E. Flatness and Levelness: Finish surfaces to flatness and levelness tolerances as follows and as measured according to ASTM E1155. Grind smooth high spots and surface defects that would telegraph through applied floor covering systems.
 - 1. Warehouse slabs (on grade) shall meet the following floor flatness requirements:
 - a. Specified values: FF – 35; FL – 25
 - b. Minimum local values: FF – 40; FL – 28
 - 2. Vehicle Bay slabs (on grade) shall meet the following requirements:
 - a. Specified values: FF – 35
 - 3. Office Floor slabs (on grade) shall meet the following requirements:
 - a. Specified values: FF – 25; FL – 20

- b. Minimum local values: FF – 20; FL – 15

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Protect concrete floor slabs indicated to remain exposed to view (no applied finish floor covering) from construction damage. Cover with protection boards, tarps, etc... to resist surface wear, soiling, paint overspray, adhesive or solder droppings, and other construction activities which may damage the finished surface.
 - 1. For concrete surfaces indicated to receive stained finish, use protection materials and methods recommended by stain manufacturer.
- C. 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.
- 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 seven days.
 - 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 12 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.
 - 3. Curing Compound: Apply uniformly in 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. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will 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. Sealer / Dust proofer: Where indicated prepare concrete surface to accept sealer and apply two (2) coats of liquid sealer in accordance with manufacturer's suggested coverage rates. Restrict areas to foot and wheel traffic while curing.

3.11 LIQUID FLOOR TREATMENTS

- A. Penetrating Densifiers and Sealers: Apply this compound on exposed floors as indicated. Application shall be made by factory certified applicator, and in strict accordance with the directions of the manufacturer and just prior to completion of construction. Spray, squeegee or roll on liquid densifier to clean, dry concrete surface at a rate no greater than 225 sf per gallon. The liquid should be scrubbed into the surface with a mechanical scrubber. Keep the surface wet with the densifier during the application process. When the product thickens, but not more than 60 minutes after initial application, the surface shall then be squeegeed or vacuumed to remove all excess liquid.
- B. Carbon Monoxide / Carbon Dioxide Exposure: General Contractor shall be responsible for monitoring interior concrete floor exposure to excessive exhaust gases containing carbon dioxide (CO₂) or carbon monoxide (CO). To minimize potential damage to interior concrete floor during slab placement and curing periods, maximum CO₂ levels shall be 4,500 parts per million and maximum CO levels shall be 15 parts per million at concrete surface within 5 feet of any source of exhaust gases. Unvented combustion heaters shall not be in operation during concrete placement, and equipment inside the building during concrete placement shall be limited to the equipment necessary to place and finish concrete. Only two concrete trucks shall be in the building at any given time, and under no circumstance shall there be any earth moving equipment, dump trucks, grading equipment, or any other motorized equipment in operation until after the interior concrete floor is placed and protected by specified curing method. Carbon Monoxide and Carbon Dioxide shall be checked using an appropriate meter from a company similar to the following: CEA Instruments, Inc., 16 Chestnut Street, Emerson, NJ 07630; Phone (201-967-5660)

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair defective areas, utilizing specified Repair Materials when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
 1. Patch a test area at inconspicuous location with specified surface patching mortar to color match. Obtain architects approval before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
- B. Mortar Scrub Coat: To be used when bonding fresh concrete to existing concrete. Mix trowel consistency bonding coat mortar consisting of one-part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve. Mixing liquid shall consist of specified latex

admixture bonding agent diluted with clean potable water at manufacturer's recommended dilution ratio. Utilize only enough mixing liquid to create trowel consistency mortar.

- 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 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified surface patching mortar scrub coat mixed per manufacturer's recommendations. Fill and compact with specified surface patching mortar before scrub coat has dried. Fill form-tie voids with specified surface patching mortar or cone plugs secured in place with scrub on surfaces exposed to view
 - 2. Patch a test area at inconspicuous location with specified surface patching mortar to color match. Obtain architect's approval 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.
- 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.
- E. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
- F. After concrete has cured at least 14 days, correct high areas by grinding.
- G. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with specified surface patching mortar or fresh concrete
- H. Correct other low areas scheduled to receive floor coverings with the specified repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
- I. Correct other interior low areas scheduled to remain exposed with an approved repair overlayment. Cut out low areas to ensure a minimum repair overlayment depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair overlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- J. Repair defective areas, except random cracks and single holes 1 inch or more 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 mortar scrub coat. Mix original concrete.

Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

- K. Repair random cracks and single holes 1 inch or less in diameter with specified surface 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 surface patching mortar scrub coat. Place patching mortar before scrub coat agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- L. Perform structural repairs of concrete, subject to Structural Engineer's approval, using epoxy adhesive and/or polymer repair mortars. The Engineer must approve the proposed repair methods and procedures.
- M. Repair materials and installation not specified above may be used, subject to Architect's or Structural Engineer's approval.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Testing Services: Tests shall be performed according to ACI 301.
 - 2. Non-Compliant Test Reports: All test reports indicating non-compliance shall be emailed or faxed immediately to all parties on the test distribution list.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Contractor shall schedule inspection of vapor barrier installation prior to placement of floor slabs with vapor barrier manufacturer. Submit a written report indicating acceptable installation or remedial action required.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide 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, pressure method, for normal-weight 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 and when 80 deg F and above, and one test for each composite sample.
5. Water content of freshly mixed concrete: AASHTO T318 "Measurement of Water Content of Fresh Concrete Using the Microwave Oven"; tested each time cylinders are made and as directed by the Engineer.
6. Unit Weight: ASTM C 567, 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.
7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - 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.
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, Structural Engineer, 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 does not comply with the Contract Documents.
- E. Flatness and Levelness Tests: Floor flatness and levelness tests on each Floor Section shall be conducted in accordance with the provisions set forth in ASTM E 1155.
1. For the purposes of this paragraph, a Floor Section shall be any rectangular area bound by column and/or half-column lines, exterior walls, interior bearing walls, or a combination thereof (i.e. minimum section area = approximately 750 sq.ft.).
 2. Floor tolerance measurements shall be coordinated by the Contractor and made by the Testing Agency within 16 hours after completion of the final troweling operation – and in all cases before forms and/or shores (if any) have been removed.
 3. Results of all floor tolerance tests shall be provided to the Contractor, Construction Manager, Architect and Owner within 24 hours after data collection. (Note: Weekends and holidays shall be ignored when computing the testing and reporting deadlines specified above.)
 4. All Floor Sections measuring below either (or both) of the specified Minimum Local F-Numbers shall be removed and replaced (in the case of slabs-on-grade), or (in the case of elevated slabs) ground and/or re-topped as directed by the Architect and Flooring Installer.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes:

- 1. Structural steel.
- 2. Field-installed shear connectors.
- 3. Grout.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

- 1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
- 2. Division 5 Section "Steel Deck" for field installation of shear connectors.
- 3. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.
- 4. Section 133419 "Metal Building Systems" for structural steel.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
- B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication details of structural-steel components.
 - 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 2. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
 - 3. Indicate and identify members and connections of the Seismic Load Resisting System. Indicate location and dimension of protected zones. Identify areas of demand critical welds.
 - 4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.
 - 5. Shop Drawings shall be drawn at 1/8-inch equals 1'-0" minimum for plans and 3/4-inch equals 1'-0" minimum for sections. Contract Drawings shall not be reproduced in whole or in part for modification into Shop Drawings. Contract Drawings modified without approval will be returned without review.
 - 6. Each sheet of the Shop Drawings shall bear the review stamp of the Contractor indicating their review and approval. Drawings without the Contractor's stamp will be returned without review.
- C. 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.
- D. Welding certificates.
- E. Mill test reports.
 - 1. Structural steel, including chemical and physical properties.
 - 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 3. Twist-off tension control bolts.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
 - 1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant. In lieu of AISC Certification, a fabricator can demonstrate five similar size projects and scope from the past three years. Submit qualifications prior to bid.
 - 2. Comply with applicable provisions of the following specifications and documents:
 - a. AISC 303.
 - b. AISC 360.
 - c. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- 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 projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
 - 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- E. Comply with applicable provisions of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- F. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

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. Connection design is delegated to the structural steel fabricator and all connections not completely detailed on the structural drawings shall be designed by the fabricator's engineer.
 1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use Load and Resistance Factor Design or Allowable Stress Design; data are given at level shown on the structural drawings.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction:
 1. Office: Structural steel framing with steel moment frames not specifically detailed for seismic resistance.
 2. Independent Warehouse Mezzanines: Structural steel framing with steel moment frames not specifically detailed for seismic resistance.
 3. Independent Maintenance Mezzanine: Light gage steel framing and reinforced masonry shear walls for seismic resistance.
 4. Independent Office Hardened Area Structure: Structural steel framing with reinforced masonry shear walls for seismic resistance.
 5. Pre-Engineered Metal Buildings: Structural systems determined by building manufacturer

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
- B. Channels, Angles-Shapes: ASTM A 36.
- C. Plate and Bar: ASTM A 36, carbon steel angles.
- D. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade C.

- E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
 - 1. Weight Class: As indicated on Drawings.
 - 2. Finish: Black, except where indicated to be galvanized.
- F. Anchor Rods: ASTM F 1554, Grade 36, unless noted otherwise on the structural drawings.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36 carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- G. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain, uncoated.
 - 2. Provide twist-off tension control bolts.
 - a. Finish: Plain, uncoated.
- H. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- I. Threaded Rods: ASTM A 36.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Washers: ASTM A 36 carbon steel.
 - 3. Finish: Plain.
- J. Welding Electrodes: Comply with AWS requirements.

2.3 PRIMER

- A. Primer: SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.4 GROUT

- A. Non-metallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360 and in Shop Drawings.
1. Camber structural steel members where indicated.
 2. Identify high-strength structural steel according to ASTM A6 and maintain markings until steel has been erected.
 3. Mark and match-mark materials for field assembly.
 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 5. Splicing structural steel members is prohibited unless shown otherwise.
 6. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 7. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- 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. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- D. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.
1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
 2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.
- E. 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.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
 2. Joint Type: Snug tightened.

- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

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: 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 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process according to ASTM A 123 as follows:
 - 1. Structural steel indicated on Contract Documents.
 - 2. All permanent exterior exposed structural steel and lintels.
 - 3. 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.

2.9 SOURCE QUALITY CONTROL

- A. Owner may engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Shop-bolted connections will be inspected for use of tension control bolts.
- E. All full-penetration welds will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, 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 will not be accepted.
 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 4. Ultrasonic Inspection: ASTM E 164.
- F. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding.
 1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
 2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.
- G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until 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. 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.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications AISC 303 and AISC 360 referenced in this Section.
- B. Provide rigid templates for anchor bolts.
- C. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
- D. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- E. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- F. Splice members only where indicated.
- G. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

- H. Do not use thermal cutting during erection.
- I. Finish sections thermally cut during erection equal to a sheared appearance.
- J. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- K. 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.

3.4 FIELD CONNECTIONS

- A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 3. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 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 will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.

d. Radiographic Inspection: ASTM E 94.

- D. 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.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.5 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: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

END OF SECTION 051200

SECTION 053100 - STEEL DECK**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Roof deck.
 - 2. Composite floor deck.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.
 - 2. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 3. Division 5 "Structural Steel Framing" for shop- and field-welded shear connectors.

1.4 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product certificates. For each type of deck
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. Research/Evaluation Reports: Evidence of steel deck's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed steel deck 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. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
 - 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- E. 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."

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.

PART 2 - PRODUCTS

2.1 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."

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BHP Steel Building Products USA Inc.

2. Consolidated Systems, Inc.
3. Epic Metals Corp.
4. Marlyn Steel Products, Inc.
5. Nucor Corp.; Vulcraft Div.
6. Roof Deck, Inc.
7. United Steel Deck, Inc.
8. Verco Manufacturing Co.
9. Wheeling Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

2.3 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Grade C, shop primed as follows:
 - a. Shop Primer: Grey or white baked-on, lead- and chromate-free rust-inhibitive primer, conforming to the performance requirements of FS TT-P-664. Galvanized-Steel Sheet: ASTM A 653, Grade A, G 60 zinc coated according to ASTM A 653.
 2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade A, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 3. Deck Profile: As indicated
 4. Profile Depth: As indicated
 5. Design Uncoated-Steel Thickness: As indicated.

2.4 COMPOSITE FLOOR DECK

- A. 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 50 minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer.
 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50, G60 zinc coating.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Span Condition: As indicated.

2.5 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 or as indicated on the structural drawings.
- D. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- E. 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. 29 for overhang and slab depth.
- F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- G. 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.
- H. Flat Receiver Pans: Manufacturer's standard size, single-piece steel sheet, 0.071-inch-thick minimum units, of same material as deck panels. Cut holes for drains in the field.
- I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
- J. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

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.

3.2 INSTALLATION - GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, requirements in this Section, and as indicated.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate decking bundles to prevent overloading of supporting members.
- D. 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.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches.

3.3 ROOF DECK INSTALLATION

- A. Fasten roof deck panels to steel supporting members as indicated, and fasten side laps of panel edges as indicated, as required to develop the minimum diaphragm shear indicated on the Drawings and as follows:
 - 1. Connector Spacing: As indicated on structural drawings.
 - 2. Side Lap Fastening: As indicated on structural drawings.
- B. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches, with end joints lapped 2 inches minimum. Lap in direction to shed water where applicable.
- C. Roof Sump Plates: Install over openings provided in roof decking, and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
- D. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Weld to substrate to provide a complete deck installation.
 - 1. Provide deck closures at all roof penetrations to prevent building air from infiltrating space above deck.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's instructions to ensure complete closure.

3.4 FLOOR DECK INSTALLATION

- A. Fasten floor deck panels to steel supporting members as indicated of the surface diameter indicated and as follows:
 - 1. Connector Spacing: As indicated on structural drawings.
 - 2. Side Lap Fastening: As indicated on structural drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as follows:

1. Connector type and spacing as indicated on structural drawings.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:
 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. 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 decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor, Architect and Structural Engineer.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: At the end of each day's work, prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on surfaces of prime-painted deck immediately after installation and apply repair paint.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Exterior non-loadbearing wall framing.
 - 2. Floor joist framing
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 7 Section "Architectural Metal Panel" for subframing for metal wall panel attachment to exterior stud framing
 - 3. Division 9 Section for interior non-load-bearing metal-stud framing and ceiling-suspension assemblies.

1.4 SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
- C. Welding certificates.
- D. Qualification data.
- E. Product test reports.
- F. Research/evaluation reports for non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60 or approved equivalent.

2.2 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.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

- a. Exterior Non-Load-Bearing Framing: Horizontal deflection of $1/360$ of the wall height. Horizontal deflection of $1/600$ of the wall height when supporting brick or stone.
 - b. Floor Joist Framing: Vertical deflection of $1/360$ 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.
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

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: 0.0538 inch (16 Ga). or as indicated on drawings.
 2. Flange Width: 1-5/8 inches, or as indicated on drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
- C. Allow for alternative valued engineered opening framing systems
RedHeader RO System manufactured by ClarkWestern Building Systems. (Designed to provide an opening alternative system for conventional interior framing and/or exterior curtain wall built-up header and jamb framing by reducing labor and components up to 50 percent)
1. Exterior systems are subject to requirements of code evaluation reports and/or shop drawings with engineering calculations signed and sealed by a registered PE (Professional Engineer).
 2. Minimum Material Thickness: As required by design
 3. Minimum Flange Width: As required by design
 4. Equivalent Products
 - a. Dietrich HDS
 - b. Brady Pro X
 - c. TSN Jamb Stud

- D. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

2.4 FLOOR JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0538 inch (16 ga), unless noted otherwise.
 - 2. Flange Width: 1-5/8 inches, minimum.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel joists.
 - 2. Flange Width: 1-1/4 inches, minimum.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Double Deflection Tracks: Manufacturer's double, deep-leg, slotted, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
- C. 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 clips.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.6 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. Cast-in-Place Anchor Bolts: ASTM F 1554, Grade 36; carbon-steel hex-head bolts; carbon-steel nuts; and flat, hardened-steel washers. Zinc coated by the hot-dip process according to ASTM A 153 Class C.
- C. Expansion Anchors (where approved for use by Structural Engineer): Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors (where approved for use by Structural Engineer): Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- 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.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- 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.
- E. Welding Electrodes: Comply with AWS standards.

2.8 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, 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 screw 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 to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance 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 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates 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. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal 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 metal framing members by welding. With acceptance of Architect, screw fastening may be permitted. Wire tying of framing members is not permitted.
 - a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity 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.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal 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.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 1. Stud Spacing: 16 inches, unless otherwise indicated.
- 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 metal framing and anchor to primary 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. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. 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 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 (38 mm).
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist Spacing: 24 inches, unless otherwise indicated on structural 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, or as indicated.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- 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.

3.6 FIELD QUALITY CONTROL

- A. Testing: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 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 metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 054400 - COLD-FORMED METAL TRUSSES

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. Cold-formed steel trusses for roofs.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for cold-formed steel studs, joists, and rafters.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. 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 trusses.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Miscellaneous structural clips and accessories.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel trusses from corrosion, deformation, and other damage during delivery, storage, and handling.

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 trusses capable of withstanding design loads within limits and under conditions indicated.
 1. Design Loads: As indicated on Structural drawings, but not less than required by prevailing Building Code.
 2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:
 - a. Roof Trusses: Vertical deflection of 1/360 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.

- C. Cold-Formed Steel Framing Design Standards:
 - 1. Floor and Roof Systems: Design according to AISI S210.
 - 2. Lateral Design: Design according to AISI S213.
 - 3. Roof Trusses: Design according to AISI S214.
- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 COLD-FORMED STEEL TRUSS MATERIALS

- A. Steel Sheet: ASTM A 1003, structural grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.

2.3 ROOF TRUSSES

- A. Roof Truss Members: Manufacturer's standard C-shaped steel sections.
 - 1. Connecting Flange Width: 1-5/8 inch, minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
 - 2. Minimum Base-Metal Thickness: 0.0329 inch.

2.4 ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, structural grade, Type H, metallic coated, of same grade and coating weight used for truss members.
- B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and Appendix D in ACI 318, greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Fasteners: Fastener system of type suitable for application, fabricated from corrosion-resistant materials, with capability to sustain, without failure, allowable load

capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

- 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.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Shims: Load bearing, of high-density multimonomer plastic, nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

2.7 FABRICATION

- A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate trusses using jigs or templates.
 - 2. Cut truss members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - 4. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance 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 metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine supporting substrates and abutting cold-formed steel trusses 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. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Fasten cold-formed steel trusses by welding or mechanical fasteners.
 - a. Comply with AWS D1.3 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; comply with requirements for spacing, edge distances, and screw penetration.
- C. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- D. Truss Spacing: As indicated on structural drawings.
- E. Do not alter, cut, or remove framing members or connections of trusses.
- F. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.
- G. Erect trusses without damaging framing members or connections.
- H. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's TechNote 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."
- I. Erection Tolerances: 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 trusses 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.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the special inspections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Field and shop welds will be subject to testing and inspecting.
- D. Prepare test and inspection reports.

3.4 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 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 metal trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054400

SECTION 055000 - METAL FABRICATIONS**GENERAL****1.1 SCOPE OF WORK**

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Miscellaneous steel framing and supports.
 - 2. Shelf angles.
 - 3. Loose bearing and leveling plates.
 - 4. Steel weld plates and angles.
 - 5. Miscellaneous steel trim.
 - 6. Metal ladders
 - 7. Metal bollards.
 - 8. Loose steel lintels.
- B. See Division 5 Section "Metal Stairs" for metal-framed stairs.
- C. See Division 5 Section "Pipe and Tube Railings" for metal pipe and tube railings.
- D. See Division 5 Section "Ornamental Railings" for ornamental metal railings.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Grout.
- B. Shop Drawings: Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- D. Templates: For anchors and bolts.
- E. Samples: For each type and finish of extruded nosing and tread.

PART 2 - PRODUCTS**2.1 METALS**

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Ferrous Metals:
 - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
 - 3. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
 - 4. Steel Tubing: ASTM A 500, cold-formed steel tubing.
 - 5. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
 - 6. Slotted Channel Framing: Cold-formed metal channels complying with MFMA-3, 1-5/8 by 1-5/8 inches. Channels made from galvanized steel complying with ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.
 - 7. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
- C. Nonferrous Metals:
 - 1. Aluminum Extrusions: ASTM B 221, alloy 6063-T6.
 - 2. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, alloy 6061-T6.
 - 3. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.2 FASTENERS

- A. General: Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI #79.

- B. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Products:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. Carboline Company; Carbozinc 621.
 - c. ICI Devco Coatings; Catha-Coat 313.
 - d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
 - e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
 - f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
 - g. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- C. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- E. Concrete Materials and Properties: 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 (20 MPa), unless otherwise indicated.

2.4 FABRICATION

- A. General: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
 - 1. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
 - 2. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
 - 3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 - 4. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - 5. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 24 inches o.c.
- B. Miscellaneous Framing and Supports: Provide steel framing and supports not specified in other Sections as needed to complete the Work. Fabricate units from steel shapes, plates, and bars of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- C. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
 - 1. Lintels in Exterior Walls: Galvanize and prime to match adjacent finishes, unless noted otherwise.

- D. Shelf Angles: Fabricate shelf angles of sizes indicated and for attachment to framing. Fabricate with horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c.
1. Shelf Angles in Exterior Walls: Galvanize.
 2. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.
- E. Loose Bearing and Leveling Plates: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts.
- F. Miscellaneous Steel Trim: Fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
1. Exterior Miscellaneous Steel Trim: Galvanize.
- G. Metal Ladders: Comply with ANSI A14.3, unless otherwise indicated.
1. Space siderails 18 inches apart, unless otherwise indicated.
 2. Steel Ladder Construction: Flat bar siderails, with 3/4-inch- diameter steel bar rungs fitted in centerline of siderails, plug-welded, and ground smooth on outer rail faces. Provide nonslip surfaces on top of each rung.
 3. Aluminum Ladder Construction: Extruded channel or tube siderails, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick; with extruded tube rungs, not less than 3/4 inch deep and not less than 1/8 inch thick, fitted into centerline of siderails and fastened by welding or with stainless-steel fasteners or brackets and aluminum rivets. Provide rungs with ribbed tread surfaces.
 4. Exterior Steel Ladders: Galvanize.
- H. Metal Bollards: Fabricate from Schedule 40 steel pipe.
1. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 2. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- thick steel plate welded to bottom of sleeve for bollards located in asphalt areas.
 3. Exterior Steel Bollards: Galvanize
 4. Exterior and Interior Steel Base Plate: Galvanize and paint to match plastic cover

2.5 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M as applicable as follows:
1. Steel indicated on Contract Documents.
 2. All permanent exterior exposed steel (painted and unpainted).

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.
- B. Steel and Iron Finishes:
 - 1. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below for environmental exposure conditions of installed metal fabrications:
 - a. Exteriors (SSPC Zone 1B) and items indicated to receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - b. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
 - 2. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
 - 1. Fit exposed connections accurately together. Weld connections that are not to be left as exposed joints but cannot be shop welded. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.
 - 2. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
 - 3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack solidly with nonshrink, nonmetallic grout.
- C. Bollards:
 - 1. Bolt down bollards in concrete areas:
 - a. Anchor bollards to existing concrete construction with expansion anchors, anchor bolts or through bolts. Provide four 3/4-inch bolts at each bollard.
 - b. Install plastic cover over bollard. Basis of Design: Traffic Safety Store Item# BOL7X52YELLOW
 - 2. Buried bollards in asphalt areas:

- a. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout.
- b. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- c. Fill bollards solidly with concrete.
- d. Install plastic cover over bollard. Basis of Design: Traffic Safety Store Item# BOL7X52YELLOW

D. Touch up surfaces and finishes after erection.

1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 312000 - EARTH MOVING**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. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, and pavements.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.
9. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
3. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.3 UNIT PRICES

- A. Quantity allowances for earth moving are included in Section 012100 "Allowances."

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.
 - 2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at Project site.
 - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.

- b. Coordination of Work with utility locator service.
- c. Extent of trenching by hand or with air spade.
- d. Field quality control.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

- 1. Geotextiles.
- 2. Controlled low-strength material, including design mixture.
- 3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

- 1. Geotextile: 12 by 12 inches (300 by 300 mm).
- 2. Warning Tape: 12 inches (300 mm) long; of each color.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

- 1. Classification according to ASTM D 2487.
- 2. Laboratory compaction curve according to ASTM D 698.

C. Seismic survey report from seismic survey agency.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.8 QUALITY ASSURANCE

A. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

- 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
- 2. Seismographic monitoring during blasting operations.

B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving 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 Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.
- C. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
- D. Do not direct vehicle or equipment exhaust towards protection zones.
- E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS**2.1 SOIL MATERIALS**

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: As defined by the Geotechnical report and/or the Geotechnical engineer on site.
- C. Unsatisfactory Soils: Soil Classification as defined by the Geotechnical report and/or the Geotechnical engineer on site.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve, unless otherwise noted.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve, unless otherwise noted.

- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve, unless otherwise noted.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve, unless otherwise noted.
- H. Drainage Course: Narrowly graded mixture of free-draining crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve, unless otherwise noted.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve, unless otherwise noted.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Refer to Geotechnical report and/or civil drawings for additional requirements of geotextiles.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I Type II or Type III.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C 33/C 33M, 3/8-inch nominal maximum aggregate size.
 - 4. Foaming Agent: ASTM C 869/C 869M.
 - 5. Water: ASTM C 94/C 94M.
 - 6. Air-Entraining Admixture: ASTM C 260/C 260M.

2.4 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows, unless required otherwise by local utilities or municipality:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 12 inches (300 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.

4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 EXCAVATION FOR ELEVATOR CYLINDER

- A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in Section 142400 "Hydraulic Elevators."
- B. Provide well casing as necessary to retain walls of well hole.

3.9 SUBGRADE INSPECTION

- A. Notify Architect and Geotechnical engineer when excavations have reached required subgrade.
- B. If Geotechnical engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons, unless defined otherwise by geotechnical engineer or civil drawings, to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical engineer, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.
 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course.
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

- H. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.14 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows, unless noted otherwise:
1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.
 - 5. Also follow any requirements for compaction as required per the geotechnical report.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch
 - 3. Pavements: Plus or minus 1/2 inch
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 or as required by the Geotechnical report.
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade or as required by the Geotechnical report.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.
- B. Prepare and place base and subbase as required per civil drawings.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. 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 Architect; reshape and recompact.
- C. 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 greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312319 - DEWATERING**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 construction dewatering.

1.3 ALLOWANCES

- A. Dewatering observation wells are part of dewatering allowance.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
 - 3. Review geotechnical report.
 - 4. Review proposed site clearing and excavations.
 - 5. Review existing utilities and subsurface conditions.
 - 6. Review observation and monitoring of dewatering system.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, land surveyor, and professional engineer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.7 FIELD CONDITIONS

- A. **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 a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 - 2. The geotechnical report is included elsewhere in Project Manual.
- B. **Survey Work:** Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. **Dewatering Performance:** Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.
- B. **Regulatory Requirements:** Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- C. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 312319

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION**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 temporary excavation support and protection systems.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review geotechnical report.
 - 2. Review existing utilities and subsurface conditions.
 - 3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
 - 4. Review proposed excavations.
 - 5. Review proposed equipment.
 - 6. Review monitoring of excavation support and protection system.
 - 7. Review coordination with waterproofing.
 - 8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
 - 3. Indicate type and location of waterproofing.
 - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor and professional engineer.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving 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, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
- B. 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 a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
 - 2. The geotechnical report is included elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
 - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.

3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- E. Tiebacks: Steel bars, ASTM A 722/A 722M.
- F. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.

2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.3 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.4 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to 95% proctor at building foundations and 90% proctor at slabs on grade density.
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

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DIVISION 21 – FIRE PROTECTION

210000	Fire Protection General Conditions
210010	Basic Fire Protection Materials and Methods
210020	Seismic Controls for Fire Protection and Equipment
210500	Fire Protection
210511	Clean Agent Fire Extinguishing System

SECTION 210000 - FIRE PROTECTION GENERAL CONDITIONS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 210000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The fire protection work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "FP Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- E. It shall be a part of this FP Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes:

Kentucky Building Code - 2018

International Fire Code - 2015

Underwriters Laboratories (UL), "Fire Protection Equipment Directory", Latest Edition

Factory Mutual Systems (FM), "Approval Guide", Latest Edition

NFPA 13 - Installation of Sprinkler Systems – 2013 Edition

NFPA 24 - Private Fire Service Mains and their Appurtenances – 2013 Edition

NFPA 25 - Inspection, Testing and Maintenance of Water-Based Fire Protection Systems – 2014 Edition

NFPA 2001 – Standard on Clean Agent Fire Extinguishing Systems – 2015 Edition

Local Code Amendments

Requirements of the Authority Having Jurisdiction

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every respect. FP Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.
- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this FP Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this FP Contractor. Ductwork, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all duct, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as curbs and sealing, etc., which are not shown on the plan view. This FP Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This FP Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.

- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. This FP Contractor, before submitting his bid, shall visit the site and thoroughly acquaint himself with conditions under which the work will be performed.
- B. Failure to fully acquaint himself with existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract. See General Conditions for additional requirements.

1.7 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations. See General Conditions for Advance Operation of Elevators.

1.8 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General, Special Conditions, and NFPA 13. FP Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The FP Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to

SSC Engineering, Inc.
Attention: Submittals
1820 Edison Ave.
Chesterfield, MO 63005
 - 4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".

- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's sole use. The FP Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the FP Contractor marked accordingly.
 - E. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
 - F. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
 - G. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this FP Contractor.
 - H. Shop drawings shall include the plan mark used on the plans.
 - I. Shop drawings and product data for equipment shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
 - J. Submittals which do not provide the required information will be returned unchecked.
 - K. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
 - L. This FP Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
 - M. The FP Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the FP Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The FP Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.
- 1.9 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS
- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed by this FP Contractor. The installing FP Contractors shall submit documentation indicating the

date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

- B. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - 2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - C. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - D. Contractor shall also submit one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
 - 1. Complete set of shop drawings.
 - 2. Copies of all submittals.
 - 3. Parts lists, wiring diagrams, piping diagrams, etc.
 - 4. Manufacturers' operating and maintenance instructions.
 - 5. As-built drawings.
 - 6. Written operating and maintenance instructions for the system.
 - 7. Copies of warranties.
 - 8. Parts list for each piece of equipment and name of local supplier.
 - 9. AHJ inspection report(s).
 - 10. Pressure test report.
 - E. At a predetermined time, prior to the facility opening, an instructional session shall take place. The installing contractors and major suppliers shall instruct the Owner's operating personnel on operation and maintenance of the systems. The installing FP Contractor shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- 1.10 RELEASE OF CAD FILES
- A. See "Release of Cad Files" at the end of this section.
- 1.11 RECORD DRAWINGS
- A. During construction, a separate set of plans at the jobsite shall be maintained by the FP Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.

- B. Locations of piping, ductwork and other concealed facilities are to be shown by the FP Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the FP Contractor in CAD format, FP Contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 WORKMANSHIP AND MATERIALS

- A. All work shall be performed in a manner acceptable to the Engineer, Architect, and the Owner, by properly trained, supervised and experienced personnel using new and clean materials, supplies, equipment, and hardware.

1.13 MATERIAL AND EQUIPMENT HANDLING AND STORAGE

- A. It is recognized that space at the project for storage of materials and products is limited. Coordinate the deliveries of electrical materials and products with the scheduling and sequencing of the work so that storage requirements at the project are minimized. In general, do not deliver individual items of equipment to the project substantially ahead of the time of installation.

1.14 GUARANTEE AND WARRANTY

- A. This FP Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year in accordance with the General Conditions.
- B. During the guarantee period, this FP Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required during this period at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.

- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this FP Contractor's bid. This FP Contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.
- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.
- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Contractor shall furnish all material, equipment, labor, services, supplies, etc., required to execute to completion all work shown on the mechanical, electrical, fire protection, and plumbing drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. This FP Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This FP Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, this FP Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. If this FP Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, this FP Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.
- C. The FP Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall furnish and install all power wiring to and connections to the equipment. Unless specifically noted otherwise, all interlock wiring shall be furnished and installed by the Electrical Contractor. Unless noted otherwise, the control wiring shall be furnished and installed by the FP Contractor furnishing the controlled equipment.

- F. Unless noted otherwise, the Electrical Contractor shall furnish and install all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a part of a factory-assembled package. Heater elements for overload relays on magnetic motor starters (except the starter's factory pre-wired with equipment) shall be sized, furnished and installed by the Electrical Contractor. Magnetic motor starters for mechanical equipment (except starter's factory pre-wired with equipment such as chillers and packaged air conditioners) shall be furnished by the Electrical Contractor. Magnetic motor starters will be provided with:
1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
 2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.
- G. Each FP Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized heater elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.
- H. Unless specifically noted otherwise, pilot controllers (flow switches, tamper switches, pressure switches, etc.) shall be furnished and mounted by the FP Contractor furnishing the controlled equipment.
- I. Electrical Work For Fire Protection Equipment: Electrical Contractor shall wire all fire protection equipment furnished by various contractors in accordance with the following general provisions:
1. Power and control wiring for flow switches, tamper switches, pressure switches, electric bells or audio visual devices, fire pumps, jockey pumps, deluge valves and control panels, dry pipe valves and control panels, and pre-action valves and control panels.
 2. Power wiring from panel to motor controllers, relays, etc., and from controller to motor terminals per equipment manufacturer's wiring diagram.
 3. Receive, unload, set and align all separately shipped motors. Adjust and align drive and adjust belt tension.
 4. Field lubricate all motors prior to initial operation of same.
 5. Install individual motor starters specifically called for to be furnished by other FP Contractors when not a factory pre-wired component.
- J. Fire Protection Contractors shall provide the following:
1. All motors disconnect switches or control devices specifically called for.
 2. Automatic control and interlock wiring diagrams as called for in the specifications.
 3. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical power wiring including motor terminal connection diagrams.
 4. Adjustable motor bases and all bolts and nuts required for installation of base and motor.
 5. Supervision of Electrical Contractor in lubrication of motors to eliminate possibility of motor starting or operating without proper lubrication and control systems.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. This FP Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this FP Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This FP Contractor shall cooperate with and coordinate with the Owner's Representative to plan and schedule the work to satisfy the schedule.
- B. All work shall be so arranged that electrical power, sewer, water, and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.
- C. All interruptions shall be scheduled, and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.
- D. Pipes which are shown to be installed or demolished in subsequent phases that are needed for earlier phases to make the earlier phase operational shall be installed or demolished in the earlier phase during non-business hours. Where later phase work is performed in an earlier phase, contractor shall remove and replace ceilings as required to perform the work.

3.5 MAINTENANCE OF WORK AREAS

- A. During the project, this FP Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.
- B. Open ends of pipe, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.6 CLEANING AND CLEANUP

- A. Upon completion of this work, the FP Contractor shall clean all pipes and equipment. FP Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. Each FP Contractor shall be responsible for his own cleanup to a central location designated by the Owner. FP Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work as directed by the Owner.

END OF SECTION 210000

RELEASE OF CAD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2018. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CAD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

Company

Version of AutoCAD used

Name (Must be an officer of the Company)

E-mail address

Title

Maximum e-mail attachment size

Date

SECTION 210010 – BASIC FIRE PROTECTION MATERIALS AND METHODS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 210000 - Fire Protection Conditions.
- C. This section covers basic fire protection materials and methods for Fire Protection work and applies to work of those sections.

PART 2 - PRODUCTS**2.1 PRODUCT CRITERIA**

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association
HEW	U.S. Department of Health, Education and Welfare
PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation
IEEE	Institute of Electrical and Electronic Engineers
AWWA	American Water Works Association

- C. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

D. Abbreviations

1.	AC	Air Conditioning Unit	40.	FT	Feet
2.	ADJ	Adjustable	41.	FS	Flow Switch
3.	AF	Anti-Freeze	42.	FURN	Furnished
4.	AFF	Above Finished Floor	43.	FS	Flow Switch
5.	AHU	Air Handling Unit	44.	GAL	Gallons
6.	AP	Access Panel	45.	GALV	Galvanized
7.	BFP	Back Flow Preventor	46.	GC	General Contractor
8.	BHP	Brake Horsepower	47.	HR	Hour
9.	BTU	British Thermal Units	48.	HP	Horsepower
10.	BOD	Bottom of Duct	49.	IE	Invert Elevation
11.	BOP	Bottom of Pipe	50.	IN	Inches
12.	BOS	Bottom of Steel	51.	INST	Installed
13.	CAP	Capacity	52.	KF	K-Factor
14.	CONN	Connected	53.	KW	Kilowatt
15.	CV	Control Valve	54.	LRA	Locked Rotor Amps
16.	CC	Center to Center	55.	MAX	Maximum
17.	CFM	Cubic Feet per Minute	56.	MC	Mechanical Contractor
18.	CI	Cast Iron	57.	MIN	Minimum
19.	CL	Center Line	58.	NO	Normally Open
20.	CLG	Ceiling	59.	NC	Normally Closed
21.	CPVC	Chlorinated Polyvinyl Chloride	60.	NO.	Number
22.	D	Drain	61.	NTS	Not to Scale
23.	DIA	Diameter	62.	PC	Plumbing Contractor
24.	DISC	Disconnect	63.	POC	Point of Connection
25.	DN	Down	64.	RND	Round
26.	EJ	Expansion Joint	65.	SW	Switch
27.	EC	Electrical Contractor	66.	STL	Steel
28.	EFF	Efficiency	67.	SG	Sight Glass
29.	EX	Existing	68.	SP	Static Pressure
30.	FCU	Fan Coil Unit	69.	SPC	Sprinkler Contractor
31.	FDC	Fire Department Connection	70.	SQ	Square
32.	FH	Floor Hydrant	71.	SQ FT	Square Foot
33.	FHV	Fire Hose Valve	72.	SS	Stand Pipe System
34.	FHC	Fire Hose Cabinet	73.	TOP	Top of Pipe
35.	FIN	Finish	74.	TS	Tamper Switch
36.	FLR	Floor	75.	UH	Unit Heater
37.	FM	Factory Mutual	76.	VAV	Variable Air Volume Box
38.	FPC	Fire Protection Contractor	77.	VFD	Variable Frequency Drive
39.	FPM	Feet per Minute	78.	VTR	Vent Thru Roof
			79.	WC	Water Column
			80.	WS	Water Flow Switch

2.3 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.
- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.4 ACCESS PANELS

- A. Access panels shall be constructed of heavy gauge steel with factory applied prime coat of baked enamel.
- B. Panel doors shall be attached to the frame with concealed hinges.
- C. Cam locks shall be provided in not less than the following quantities:

Panel Height (Opposite side of hinges)

0 to 18"	1 cam lock
18-1/16" to 30"	2 cam locks
30-1/16" to 48"	3 cam locks
48-1/16" to 60"	4 cam locks

Panel Width

0 to 18"	No cam locks on top or bottom
18-1/16" to 30"	1 cam lock top and bottom
30-1/16" to 48"	2 cam locks top and bottom

- D. On the panel height, one of the cam locks described above shall be a key operated cylinder lock in lieu of the cam lock. One key shall operate all panels.
- E. Cam locks shall have tamper-proof heads. Provide 10 tools to the owner.
- F. For masonry, tile or wallboard surfaces, provide access panels with extruded aluminum frames, 3/4" border, aluminum piano hinges, screwdriver-operated cam lock, brushed satin aluminum finish. Final painting to match interior decor by others. Paintable finish to be provided when the adjacent construction is paintable.
- G. Access panels will not be required in accessible type ceilings.
- H. For plastered ceiling or wall, concealed flange, recessed door panel to receive plaster by others, continuous hinges, flush latch, white prime coat finish. Final painting to match interior decor by others.
- I. For locations concealed from public, snap catch latches may be used.
- J. Manufacturer - Panels shall be equal to Inryco/Milcor type K for plaster, type DW for drywall, type M for masonry.

2.5 SLEEVES

- A. Exterior And Foundation Walls: All piping through exterior or foundation walls shall pass through schedule 40 galvanized steel sleeves which shall be large enough to allow for caulking material. No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved by the Engineer.
- B. Interior Walls and Partitions: All piping through interior walls and partitions that are fire rated shall pass through either schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves. Schedule 40 steel pipe sleeves must be used when required for structural purposes.
- C. Floors: All piping through floors shall be provided with schedule 40 carbon steel pipe sleeves, extending 2 inches above floor except in finished areas. Sleeves in finished areas shall terminate flush with floor, and shall be schedule 40 carbon steel pipe.

2.6 BACKING AND SEALANTS

- A. Backing and sealant for piping and ducts passing through floors, plaster ceilings, partition, and walls shall be as follows:
 - 1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
 - 2. Sealant: Gun Grade. An 1-part modified polyurethane, gun applied, elastic sealant, "Dymonic" by Tremco, or Chem-Calk 900 by Bostik.
 - 3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.
 - 4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following: 1) "SpecSeal" by Specified Technologies Inc. 2) 3M, 3) Chase Technology Corporation, 4) Link-Seal, 5) Pyro-Pac by Thunderline Corporation, 6) "Fyre Seal" by Tremco, 7) Pensil 100 by General Electric, 8) Pensil by STI, or 9) "Flameseal" by G. S. Nelson Electric.
 - a. Acrylic 1-part silicone rubber, gun applied, fire retardant elastic sealant, "Fyre Seal" by Tremco.
 - b. Silicon foam sealant, CTC PR-855 by Chase Technology Corporation.
 - c. Fire stop putty. "Flameseal" by G. S. Nelson Electric.
 - d. Intumescence Sealant (SpecSeal SSS100) shall be one-part, two stage intumescent latex compound, expands a minimum of 8 times when exposed to 230°F to

>1000°F, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, red in color, and safe for contact with plastics.

- e. Flexible Sealant (SpecSeal LC150) shall be one-part, latex-based compound, flexible and non-shrinking when dry, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, blue in color, and safe for contact with plastics.
- f. Flexible Silicone Sealant (SpecSeal Pensil 300) shall be one-part, neutral curing silicone, completely water resistant, contain no solvents nor inorganic fibers, allow movement of +/-50%. Sealant shall be auto-bonding, ozone and UV resistant, chemical resistant and capable of caulking or troweling on to vertical surfaces or overhead.
- g. Intumescence Putty (SpecSeal Firestop Putty) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- h. Putty Pads (SpecSeal Firestop Putty Pads) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- i. Pillows (SpecSeal Firestop Pillows) shall be an intumescent pillow heat sealed in a fire-retardant poly bag with a monolithic core encapsulated by flexible intumescent coating and shall expand when exposed to 230°F to >1000°F.
- j. Mortar (SpecSeal Firestop Mortar) shall be light weight, fast drying, portland cement based, wet mortar density shall be ≤52 lb./cu.ft., dry mortar density shall be ≤45 lb./cu.ft., approved for combustible and noncombustible penetrants, have chemical adhesion, and be red in color.
- k. Silicone Foam (SpecSeal Pensil Silicone Foam) shall be two-part, silicone, room temperature curing foam, completely water resistant, contain no solvents nor inorganic fibers, allow movement of expansion, contraction and vibration.
- l. Intumescent Collars (SpecSeal Firestop Collar) shall be factory assembled collar utilizing a molded two stage flexible intumescent insert, insert shall expand a minimum of 15 times when exposed to 230°F to >1000°F, suitable for CPVC, ABS, ABS Foam Core, and FRPP pipes.
- m. Intumescent Wrap Strips

- 1) (SpecSeal Firestop Red Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 15 times when exposed to 230°F to >1000°F.
 - 2) (SpecSeal Series Blu Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 30 times when exposed to 230°F to >1000°F.
- n. Intumescent coatings (SpecSeal Cable Coating) shall be water based, intumescent coating, expand a minimum of 5 times its dry applied thickness, flexible, water and weather-resistant film, contain no solvents or inorganic fibers. Coating shall be thixotropic and be capable of being applied by brush application or by airless spray.
- o. Urethane Joint Sealants
- 1) Subject to compliance with requirements, provide one of the following:
 - a) Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
 - b) Polymeric Systems, Inc.; PSI-901.
 - c) Approved equal.
 - 2) Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS for vertical surfaces or Grade P for horizontal, Class 50, for Use "NT" for Non-Traffic.

2.7 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.8 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, boxes, panels, etc., shall be furnished and installed by the Contractor requiring the opening.
- B. Lintels furnished shall be structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.9 CUTTING

- A. All openings for conduit, pipes, etc., shall be provided by each Contractor by means of sleeves or framed openings.
- B. Each Contractor shall be responsible for any cutting required for conduits, pipes, etc., if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the

Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.

- C. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., each contractor shall obtain the Owner's approval in advance of the cutting and patching.

2.10 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching and shall be subcontracted to the Owner's Painting Contractor.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching and shall be subcontracted to the Owner's Painting Contractor.
- C. Surfaces with finishing materials - Such as tiled, paneled, stone or marble surfaces, patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching and shall be subcontracted to the Owner's Interior Furnishing Contractor doing the specific finish work.

2.11 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be Allen Systems, Inc., W.H. Brady Co. - Signmark Div., or Industrial Safety Supply Co., Inc.
- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.
- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high letters. Provide 5/32" hole for fastener. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for proper attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name and plan number, 2) Equipment service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.12 CEMENT GROUT

- A. Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

2.13 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall furnish and install all bases, anchor bolts, and structural steel to support the equipment, piping, etc., furnished and installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Concrete housekeeping pads to be provided by Division 3. Concrete housekeeping pads shall be a minimum of 3-1/2" high, unless detailed otherwise, under all equipment, pumps, etc., in the equipment rooms where piping containing water is located. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be 1/2" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment. Plywood shall be fire resistant treated in Type I and Type II Buildings.

3.2 DRIVE AND COUPLING GUARD

- A. Contractor shall furnish and install coupling or belt guards on all drives which do not have guards factory installed. Belt guards shall enclose drive on all sides and shall comply with requirements of governing agencies.

3.3 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

- A. This Contractor shall ascertain from his examination of the architectural and structural drawings whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary. The Contractor shall pay all cost of making such openings or providing such supports.

3.4 CUTTING AND PATCHING

- A. All cutting that may be necessary for the installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut. No openings shall be cut without written approval of the Owner's Representative.
- B. Repair of Spray Fire Proofing Materials
 - 1. Where fireproofing materials are damaged during the installation of the fire protection system, fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied or patching materials recommended by the manufacturer. Repaired areas shall be retested and re-inspected. Fireproofing material shall be applied by hand-trowel, or by respraying. Coordinate with General Contractor and Spray Fire Proofing contractor.

3.5 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.6 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor requiring access shall provide access panels.
- C. Contractor shall not provide access panel to equipment above drywall ceilings in sales areas or restrooms without written permission of Architect/Engineer.

3.7 PAINTING

- A. All pieces of mechanical equipment shall be factory finished machinery-grey or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.
- B. This Contractor shall paint the following items:
 - 1. Items specified under "Demolition and restoration of facilities", Section 210000 shall be painted.
 - 2. No other painting is required unless specifically called for on the plans.
 - 3. Coordinate with Architect for painting of exposed piping.

3.8 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves through outside walls shall be cut smooth and shall be flush with each side of the wall.
- C. Sleeves through floors shall extend 2" above finished floors.
- D. Sleeves in foundation walls or footings shall be as detailed on the plans. No sleeves, other than those shown on the drawings, shall be installed through footings or foundations without obtaining approval from the Structural Engineer.
- E. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. Sleeves shall be grouted in place.
- F. Where pipes pass through existing foundation walls or concrete walls below grade, the hole shall be core drilled.
- G. Where pipes pass through firewalls composed of plaster or drywall, fire sealant shall be applied around the outside of the sleeve to seal between sleeve and wall per UL requirements.
- H. The internal diameter of sleeves shall be 1" larger in diameter than the outside diameter of the pipe or pipe insulation. Insulation shall be continuous through sleeve.
- I. The space between the pipe and the sleeve shall be sealed with fire resistant silicon foam sealant, CTC PR-855 by Chase Technology Corporation, or equal. Link-Seal, Pyro-Pac by Thunderline Corporation is acceptable in lieu of the silicon foam sealant listed above. "Flameseal" fire stop putty by G. S. Nelson Electric is also acceptable. Products used shall be U.L. Classified, shall produce non-toxic fumes, and shall be asbestos free.
- J. Where pipes pass through concrete walls below grade, the space between the pipe and the core drilled hole or sleeve shall be completely filled. Caulk outside with lead wool packed watertight. Caulk outside surface between pipe and sleeve or hole with General Electric, or equal, silicon caulking. Link-Seal as described above is acceptable in lieu of lead wool.

- K. Chrome plated escutcheons shall be provided at all locations where pipes penetrate walls in exposed locations.
- L. Interior Non-Rated Walls/Partitions:
 - 1. Concealed locations: Limit the size of the space between the wall and the outside of the pipe to 1" maximum. The space between the pipe and the wall may be left open.
 - 2. Visible Locations: Openings between pipes and wall shall be covered with chrome plated escutcheons.
- M. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:
 - 1. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.), the pipes shall be sealed per approved methods to meet U.L. Classifications.

3.9 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:
 - 1. Adjacent to each valve.
 - 2. At each branch or riser take-off.
 - 3. Where piping goes through floors, walls or ceilings.
 - 4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.
- B. All color coding shall comply with ANSI A13.1 1975.
- C. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.
- D. Provide valve tag on every valve and control device in each piping system; exclude check valves and valves within factory-fabricated equipment units. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.
- E. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and plan number and) B Equipment service, matching terminology on schedules as closely as possible.

3.10 LINES AND GRADES

- A. This Contractor shall set all construction stakes required for establishing the lines and grades for underground piping and equipment. He shall assume full responsibility for dimensions and elevations measured from such stakes and reset all stakes displaced or moved while the work is in progress.
- B. This Contractor shall coordinate all elevations and dimensions shown on the drawings with the General Contractor and other subcontractors and report any discrepancies to the Engineer. No work shall be installed until all discrepancies have been resolved.

3.11 EXCAVATION

- A. Excavate, as necessary, for all underground piping, conduit, etc., as indicated on drawings and/or necessary.
- B. Material to be excavated shall be non-classified and shall include all earth or other materials encountered. The contract price shall cover the removal of all such material to the depth and extent indicated on the drawings and/or herein specified.
- C. Unless otherwise shown, provide separate trenches for each utility. Lay all piping in open trench except when the Engineer gives written permission for tunneling.
- D. Excavation of trenches from surface to top of pipe shall be kept to a minimum but shall be of sufficient width for proper installation of the work. The excavation from bottom of trench to top of pipe shall be not more than twenty (20) inches wider than the outside diameter of the pipe to be laid therein, or where depth of backfill over pipe exceeds ten (10) feet, width of trench at top of pipe shall not exceed $4/3$ of nominal diameter of pipe, plus eight inches. For larger pipe, the bottom of trench shall be shaped to conform to the lower half of pipe, and recesses four (4) inches in length shall be cut for pipe bells as required, to give uniform bearing making certain that the pipe is properly supported throughout. Provide ample excavation under and around all pipe joints to permit proper caulking, sealing, welding or thread tightening.
- E. All excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be securely held by bracing or sheeting, which bracing and sheeting shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., to be used by this Contractor shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.
- F. Grading in the area of the excavation will be such that it shall prevent surface water from flowing into the excavated trench. Under no circumstances lay, pipe or install appurtenances in water. Keep trench free from water until pipe joint materials have hardened. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the contract price.
- G. Where underground lines cross, the trench of the lower pipe shall be backfilled with sharp sand, well tamped, to provide bed for higher pipe. Lines which run parallel and at different levels shall be adequately separated to provide firm bedding for the lines. Sewer, water and gas lines shall be run in completely separate trenches, and at least three (3) feet apart at center lines, except as approved by the Engineer. Whenever possible, water lines shall be installed above sewer lines and gas piping above water and sewer lines.

3.12 BACKFILLING

- A. All excavations by this Contractor shall be promptly backfilled.

- B. Trenches for sewers, piping, conduit, etc., shall be backfilled for a depth of at least one (1) foot over the top of pipe with sand. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed beneath haunches of piping and thoroughly compacted to prevent lateral displacement.
- C. Backfill from 1'-0" above the top of the pipe to the surface shall be with clean on-site materials. Large rocks (over 3/4") or other materials shall be removed. Backfill shall be compacted. Compaction shall be at least 90% measured by the Proctor Test (ASTM D 698). Backfill shall be constructed in uniform layers of approximately 6 to 8 inches in loose dimension. Each layer shall be compacted.
- D. Backfill from 1'-0" above the top of the pipe, sewer, conduit, etc., to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of 1/2".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, re-compacted, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, dry by discing or other similar methods. If the soils are too dry during construction of the fill, add water in such a way as to permit uniform dispersion of the moisture through the layer to be compacted.
- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 210010

SECTION 210020 – SEISMIC CONTROLS FOR FIRE PROTECTION PIPING & EQUIPMENT**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Provide seismic restraints as indicated for each type of equipment and for piping systems. This section applies to Fire Protection Systems.
- B. Scope of work
 - 1. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
 - 2. Seismic control manufacturer shall have the following responsibilities:
 - a. Determine seismic restraint sizes and locations.
 - b. Provide piping and equipment seismic restraints as scheduled or specified.
 - c. Provide installation instructions and drawings.
 - d. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, and project seismic requirements. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
 - 3. Friction from gravity loads shall not be considered resistance to seismic forces.
 - 4. All piping shall to be restrained per NFPA 13. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 210000 - Fire Protection General Conditions.
- C. Section 210010 - Basic Fire Protection Material and Methods.
- D. Section 210500 – Fire Protection.

1.3 REFERENCES

- A. NFPA 13 (Reference Specification Section 210000 for Edition)

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Restraint Loading:
 - 1. Site Class as Defined in the IBC: D
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: III

- a. Component Importance Factor: See Schedule on drawings.
- b. Component Response Modification Factor: See Schedule on drawings.
- c. Component Amplification Factor: See Schedule on drawings.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 20.3%
4. Design Spectral Response Acceleration at 1-Second Period: 16.6%
5. Seismic Design Category: C

1.6 SUBMITTALS

A. Product Data: For the following:

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, and seismic restraints.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Seismic Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings shall be based on independent testing. If preapproved ratings are not available, submittals shall be based on independent testing. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD or an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- C. Specification SC: Restraint Cables:
 - 1. ASTM A 603 galvanized for interior locations and ASTM A 492 stainless for outdoor locations -steel cables with end connections made of galvanized/stainless steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Accessories shall be the same material as the cable. Mason Industries, Type SCB Seismic Slack Cables and Type SRC Seismic Rod Clamps.
 - 2. Strut System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels (struts), 1-5/8 wide, in varying lengths and combinations to meet load

capacities, with accessories for attachment to braced component at one end and to building structure at the other end and other matching components; and rated in tension, compression, and torsion forces. 12 gage channels unless otherwise indicated in the approved submittals. Cooper B-Line model B22 strut systems, pipe hangers, and accessories.

- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Mason Industries Seismic Rod Clamps or B Line SC-228 or SC-UB Hanger Rod Stiffener.
- E. Specification SG: Seismic Grommets. Resilient Isolation Washers and Bushings. One-piece, molded, oil- and water-resistant neoprene, with a flat washer face. The grommets shall be used with a steel washer between the bolt head (or nut if studs are used) and the grommet face. All anchor bolts shall be tightened until there is obvious grommet distortion and the bolt is torqued to 80% of allowable. In no case, shall the anchor bolt torque be less than 50% of the allowable. Mason Industries, Inc. Type HG.
- F. Specification SAB: Seismic Anchor Bolts
 - 1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. Mason Industries, Inc. Type SAB.
 - 2. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Mason Industries, Inc. Type SAA.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use except as otherwise indicated.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic/wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 210010 for installation of equipment supports.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127 and NFPA 13.
 - 2. Space lateral supports and longitudinal supports at no more than the maximum of spacing indicated on the drawings or the local building code.
 - 3. Brace a change of direction as indicated on the drawings or the local building code.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 percent. Single sided "C" beam clamps shall not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.
- F. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure:
 - 1. Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
 - 2. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the seismic restraint vendor's calculations.
 - 3. Capacity for concrete inserts used for support attachment shall not exceed the combination of gravity and seismic loads on the support.
- J. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 210500 "Fire Protection Systems" for piping flexible connections.

3.5 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 FIRE PROTECTION VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. See schedule on plans.

END OF SECTION 210020

SECTION 210500 – FIRE PROTECTION**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Provide all labor, services, material and related items necessary to complete the fire protection work indicated on the drawings and/or specified herein. Sprinkler locations are shown on the drawings; contractor shall design the piping to feed the sprinklers and perform hydraulic calculations of the system in accordance with NPFA 13. Sprinkler systems shall comply with performance requirements and design criteria; include analysis data signed and sealed by the qualified professional engineer, licensed in the jurisdiction of the project, and responsible for their preparation.
- B. The contractor shall include in this contract, at no additional cost, any sprinklers not shown on the drawings, but required by NFPA 13 or the local authority having jurisdiction.
- C. Provide a working installation complete in every detail with all items necessary for such an installation whether or not specifically mentioned herein or shown on the drawings.
- D. Provide all labor, services, material and related items necessary to complete the fire protection work indicated on the drawings and/or specified herein, in accordance with NPFA 13.
- E. Work to be performed shall include, but not be limited to the following fire protection systems:
 - 1. Wet-pipe sprinkler system
 - 2. Dry-pipe sprinkler system
 - 3. Private Fire Service Mains
 - 4. Clean Agent System - See Specification Section 210511

1.2 RELATED SECTIONS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 210000 - Fire Protection General Conditions
- C. Section 210010 - Basic Fire Protection Material and Methods
- D. Section 210020 - Seismic Controls For Fire Protection Piping and Equipment
- E. Section 210511 - Clean Agent Extinguishing System
- F. Division 26 – Electrical

1.3 REFERENCES

- A. All work shall be designed and installed in accordance with all applicable codes and referenced design standards. Refer to Section 210000 Fire Protection General Conditions for applicable codes and standards.

1.4 QUALITY ASSURANCE

- A. All materials and equipment under this section of the specifications shall be approved by Factory Mutual and Underwriter's Laboratories for fire protection systems installation.

1.5 REGULATORY REQUIREMENTS

- A. All work shall be installed in accordance with the currently enforced edition of the National Fire Protection Association 13 and shall meet the requirements of the Owner, the local Fire Marshal and the municipal Department of Building Regulations.
- B. The system shall not be accepted until final testing and receipt of the Contractor's Material and Test Certificate, Part "A" General.

1.6 SUBMITTALS

- A. The fire protection drawings have been prepared using Autocad. The fire protection plan drawing files will be made available to the successful automatic sprinkler contractor either in the form of a diskette or by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed; see Section 210000. Utilization of these documents for the development of shop drawings and submittals does not relieve the sprinkler contractor from any of his responsibilities herein. By accepting these drawing files, the sprinkler contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files.
- B. Complete shop drawings shall be submitted for their approval as follows:
 - 1. Through the General Contractor to the Engineer
 - a. Quantities of shop drawings shall be as indicated in Section 210000. Submittal must be comprehensive of the entire project, complete in all details and at the same scale as the Architectural plans. Submit shop drawings and hydraulic calculations that have been sealed by the qualified professional engineer responsible for their preparation. Hydraulic calculations shall include velocity, end pressure and flow at each sprinkler in the remote areas, in addition to other NFPA 13 criteria.
 - b. Manufacturer's literature on all system equipment, pipe and fittings. Literature shall clearly identify exactly what components are being provided including finish, size, type and options.
- C. Shop drawings shall also be submitted to all local authorities and the Owner's insurance carrier prior to fabrication and the start of work.
- D. Certificate of Installation: Submit certificate upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13, and also that system is operational, complete, and has no defects.
- E. Operation and Maintenance Data: Submit operation and maintenance data and parts lists for fire protection material and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation, and record drawings in Maintenance Manual in accordance with requirements of Division 1.

- F. Shop Drawings: Shall include plans, pipe elevations, riser sections, stairway/standpipe sections, details, and attachments to the structure, prepared according to NFPA 13. Include a hydraulic summary for each remote area and clearly labeled hydraulic nodes corresponding to the hydraulic calculations. Shop Drawings shall be signed and sealed by the qualified professional engineer, licensed in the jurisdiction of the project, and responsible for their preparation.
- G. Submit product data for all equipment, piping, sprinklers, hangers, structural attachment devices, etc. Product data submittals shall indicate the specific model number of products to be provided. Finish colors of sprinklers and exterior equipment shall be indicated. Items that are shown on combined data sheets that will not be provided shall be marked to indicate they are excluded from the product submittal.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, type, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide size and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection piping systems. Where more than one type of material or products are indicated, selection is Installer's option.

2.2 IDENTIFICATION

- A. Install fire protection signs on piping in accordance with NFPA 13 requirements.

2.3 MATERIALS

- A. All material and equipment furnished shall be listed by Underwriter's Laboratories, Inc. as approved for the fire protection services and installed in accordance with the recommendations of the specific manufacturer.
- B. All materials used outside of the building envelope shall be designed for exterior use in a wet environment and shall be protected via material composition or coatings from corrosion / rusting.

2.4 DESIGN

- A. Refer to the Fire Protection Coversheet for densities which have been established by NFPA 13 and shall be used by the Sprinkler Contractor in the design and hydraulic calculations.
- B. Refer to Fire Protection Coversheet for flow test information and requirements.
- C. The information given herein and on the plans is as exact as could be secured for bidding purposes, but its accuracy is not guaranteed. This Subcontractor must examine the job conditions and verify all measurements, distances, elevations, clearances, pipe sizes, etc. before starting his work.
- D. The Contractor shall provide all necessary offsets, raises or drops in piping and auxiliary drains required by building conditions whether or not shown on the plans.

- E. Piping is to be held as high as possible and maintain natural drainage back to the main system risers whenever possible.

2.5 HYDRAULIC CALCULATIONS

- A. Hydraulic calculations shall be prepared on form sheets that include a summary sheet, a graph sheet, a water supply analysis, a node analysis, and detailed worksheet per NFPA 13.
- B. Hydraulic calculations shall be signed and sealed by the qualified professional engineer, licensed in the jurisdiction of the project, and responsible for their preparation.
- C. Contractor shall verify safety factor requirements with the local Authority Having Jurisdiction. The hydraulic safety factor provided based on calculation results shall be clearly stated on the submitted hydraulic calculations, both percentage and pressure value.
- D. Hazard classifications for fire protection system design, installation and water supplies shall be in accordance with NFPA Standards. Shop drawings shall indicate the Hazard Classification for each area.

2.6 COORDINATION AND PIPE SIZING

- A. Pipe sizes and routing, and exact sprinkler location shall be based on hydraulic calculation and spacing requirements. This Contractor shall be responsible for total coordination of the reflected ceiling plan using the engineered HVAC, electrical and architectural plans.

2.7 OVERHEAD PIPE AND FITTINGS

- A. Black Steel Pipe
 - 1. Sprinkler piping 2-1/2" and larger shall be, at a minimum, Schedule 10 black steel pipe designed to withstand a working pressure of not less than 175 P.S.I.
 - 2. Sprinkler piping 2" and smaller shall be, at a minimum, Schedule 40 black steel pipe designed to withstand a working pressure of not less than 175 P.S.I.
 - 3. Fittings shall be 175 P.S.I. threaded or flanged black cast iron or approved equivalent such as mechanical groove or welded construction. Plain end fittings such as "Vic Fitt" and push-type fittings shall not be allowed.
 - 4. Piping is to be held as high as possible where exposed.
 - 5. Wet system pipe may be installed level as per NFPA 13.

2.8 FLEXIBLE CONNECTOR ASSEMBLY

- A. Designed for installation above suspended ceilings and consisting of a flexible metallic hose assembly with an inlet nipple and a straight or 90 degree bend type reducing fitting plus a support bracket to position and secure the sprinkler end to ceiling support tees. The galvanized steel bracket shall accurately locate the sprinkler in the center of the ceiling grid. Flexible hose shall have a corrugated, type 304 stainless-steel inner tubing covered with stainless-steel wire braid with steel nipples welded to hose. 175-psig minimum working-pressure rating. Threaded ends; 1" inlet and ½" or 3/4" outlet (sprinkler end).
- B. Manufacturers:

1. FlexHead Industries.
2. EasyFlex.
3. SprinklFlex.
4. Victaulic VicFlex.
5. Approved Equivalent.

2.9 DRY SYSTEM PIPE FITTINGS

- A. Sprinkler piping 2-1/2" and larger shall be black steel Schedule 10 minimum steel pipe designed to withstand a working pressure of not less than 200 P.S.I.
- B. Sprinkler piping 2" and smaller shall be black steel Schedule 40 minimum steel pipe designed to withstand a working pressure of not less than 200 P.S.I.
- C. Fittings shall be 250 P.S.I. threaded or flanged black cast iron or approved equivalent such as mechanical groove or welded construction. Plain end fittings such as "Vic Fit" shall not be allowed.
- D. Where a fire pump is connected to the new or existing fire protection system, and the pump discharge pressure exceeds 175 psi all piping, fittings and valves shall be rated for 300 psi.
- E. Piping is to be held as high as possible where exposed.

2.10 UNDERGROUND PIPING

- A. Piping to 5' from building exterior:
 1. Piping shall be cement lined ductile iron, AWWA 151, working pressure psi, exterior bituminous coated. Fittings shall be ductile iron, bolted flanged or mechanical joint type, class 150 fittings. Rubber gaskets, AWWA C111. Piping shall be listed for fire protection service. Push-type fittings are not permitted.
- B. Piping beyond 5' from building exterior:
 1. Provide one of the following materials:
 - a. Piping shall be cement lined ductile iron, AWWA 151, working pressure psi, exterior bituminous coated. Fittings shall be ductile iron, bolted flanged or mechanical joint type, class 150 fittings. Rubber gaskets, AWWA C111. Piping shall be listed for fire protection service. Push-type fittings are not permitted.
 - b. High Density Polyethylene, ASTM D3350, rated at a minimum of 200 psi.
 - 1) HDPE joining methods shall be one of the following:
 - a) Butt fusion
 - b) Electrofusion couplings PE3608 HDPE, rated at minimum 200 psi
 - c) Provide installer's Heat Fusion Training certificate
 - c. HDPE Pipe joining methods, installation, bedding and backfill shall be per manufacturer's installation requirements.
- C. All underground piping shall be installed in accordance with the latest edition of NFPA 24.

- D. Piping shall be listed for fire protection service.
- E. All bends and tees are to be adequately supported with thrust blocks to prevent rupture of joints due to movement of pipe.
- F. All underground piping shall be flushed in accordance with NFPA 24. The underground shall be flushed while flowing the required GPM for a sufficient time to ensure thorough cleaning. Flushing shall be witnessed by an authorized representative of the Owner or the authorities have jurisdiction and shall require advance notice of 24 hours.
- G. All underground pipe shall be tested in accordance with NFPA 24 and NFPA 13. Contractor's Material and Test Certificate, Part "A" General and Part "B" Underground Piping as shown on NFPA 13 shall be completed and submitted to the Engineer. (Also see "TESTING" under Part 3 below.)

2.11 HANGERS AND SLEEVES

- A. All hangers to be of approved materials and spaced in accordance with NFPA 13. The section modulus required by NFPA 13 shall be provided for all trapeze members supporting piping.
- B. Sleeves shall be set for all pipes passing through concrete floors, foundations and masonry walls.
- C. Provide escutcheon plates at all wall penetrations.
- D. See Section 210010, BASIC MATERIALS AND METHODS, for requirements for sleeves in both new and existing construction.
- E. Piping and support systems shall be seismically braced in accordance with Section 210020 and NFPA 13 and its appendices.
- F. Horizontal pipe supports shall be spaced as specified NFPA 13 and a supports shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads in excess of 50 pounds, suspended from steel joists, shall have the hanger loads suspended from panel points. Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.
- G. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers.

2.12 TEST AND DRAIN CONNECTIONS

- A. Provide combination inspector's test/main drain valve with pressure relief, 2" diameter with a 1/2" test orifice. Drain valve shall discharge through an exterior wall onto a splash block furnished by the sprinkler contractor.
- B. Auxiliary drains consisting of plugs, or globe valves and plugs where capacity of trapped pipe section exceeds five gallons, shall be provided to drain all points in the system that cannot be drained back to a main riser as shown on the plans.

1. A label shall be provided below ceiling indicating location of auxiliary drain. For drain valves exposed, provide a permanent tag marker as required in Specification 210010 Section 2.11.
2. Auxiliary drains shall be accessible from a standard 8ft ladder and be clear from conflicts with other disciplines, including mechanical equipment, structure, and other materials. Drain valves determined to not be accessible per the design team or owner shall be relocated as required.

2.13 INSPECTOR'S TEST CONNECTION

- A. Provide inspector's test connections for the system as required. UL Listed, bronze body, with chrome plated bronze ball, brass stem, steel handle, Teflon seat and site glasses. Connect to drain riser and route to standpipe in sprinkler room.

2.14 EXTERIOR VALVES - None.

2.15 INTERIOR VALVES

- A. Gate valves shall be 175 P.S.I. working pressure, approved indicating type, rising stem, O.S. & Y valve. Acceptable manufacturers: Milwaukee, Mueller, Nibco, Stockham, Viking or approved equal.
- B. Butterfly valves shall be 175 P.S.I. working pressure, approved indicating valve. Acceptable manufacturers: Victaulic, Nibco, Gruvlok, Tyco, Viking or approved equal.
- C. Check valves shall be 175 P.S.I. working pressure horizontal swing or wafer check valves. Acceptable manufacturers: Mueller, Nibco, Stockham, Tyco, Gruvlok, Victaulic, Viking or approved equal.
- D. Globe valves shall be 175 P.S.I. working pressure, bronze threaded globe valves with renewable composition disc. Acceptable manufacturers: Crane, Milwaukee, Nibco, Stockham or approved equal.
- E. Automatic air vent valves shall be an Engineered Corrosion Solutions PAV-WS Ejector automatic air vent, Tyco TAV-W, or approved equal. Minimum 175 P.S.I service pressure. Valve shall contain float mechanism with a redundant design to eliminate the need to connect the valve to a drain. Valve shall either include a manufacturer provided pressure switch or a field provided pressure switch.

2.16 SUPERVISORY SWITCHES

- A. All valves on the sprinkler system shall be supervised. Valve switches to be furnished and installed by the Sprinkler Contractor and wired by the Electrical Contractor to the fire alarm control panel. Valve supervisory switches shall be Potter, Guardian, System Sensor or approved equal.

2.17 SPRINKLERS

- A. Acceptable sprinkler manufacturers: Tyco, Globe, Reliable, Victaulic, and Viking. Only sprinklers manufactured after January 1, 2004, shall be acceptable.

- B. Furnish and install sprinklers as shown in "Sprinkler Schedule" on Fire Protection Coversheet.
- C. Sprinkler guards are to be provided on all sprinklers located less than 7'-0" from finished floor and where subject to mechanical injury.
- D. High temperature sprinklers of proper degree rating shall be installed in boiler room, storage areas or where necessary.
- E. All sprinklers shall be provided with the appropriate temperature and response rating based on location and occupancy. Contractor shall verify the location and temperature of all heat producing equipment.
- F. Extended coverage sprinklers shall be provided only where the water supply is sufficient to supply the listed pressure. Where the water supply is not sufficient, standard coverage sprinklers shall be provided.
- G. Furnish and install at the system riser twelve-head sprinkler cabinet(s), each stocked with a sprinkler wrench and extra sprinklers as required by NFPA 13. The quantity, types and temperature rating of extra sprinklers shall be in proportion to those installed on the system.

2.18 BACKFLOW PREVENTER

- A. Provide where shown on drawings a U/L listed double gate valve, double check detector assembly backflow preventer. Gate valves to be O.S.&Y. type. Unit to be Febco, Ames or Watts, equal to Watts Model #709 DCDA. Provide supervisory (tamper) switches on gate valves. Switches shall be wired to the fire alarm by the Electrical Contractor. Backflow preventer shall be listed for use in fire protection systems.

2.19 FIRE DEPARTMENT CONNECTION

- A. Fire department connection shall be equal to Potter Roemer Model #5710, UL 405, cast brass body; NH-standard thread inlets according to NFPA and matching local fire department threads; and threaded NPS outlet. Include lugged cap, gasket and chain; lugged swivel connection, extension pipe nipples, and clappers for each hose connection inlet; and wall extension plate with marking "AUTO-SPR". Provide locking caps (Knox brand or equivalent) where required by the Authority Having Jurisdiction.
 - 1. Connections: Two 2-1/2" inlets and 4" outlet.
 - 2. Inlet alignment: In line, horizontal.
 - 3. Clapper Type: Drop clappers in body.
 - 4. Clapper Type: Female clapper snoots.
 - 5. Direction of outlet: Back.
 - 6. Escutcheon Plate: Rectangular.
 - 7. Finish: Chrome. Coordinate finish with Architect.

2.20 WATER FLOW SWITCHES

- A. Vane water flow detectors shall be designed to signal any flow of water that equals or exceeds 10 GPM. Detector switch mechanism shall incorporate an instantly recycling mechanical retard element with an adjustable range of 0 to 60 seconds. Two single pole, double throw

switches shall be provided suitable for operation on 24-volt D.C. or 110-volt A.C. Detectors shall be of dust tight construction. Detector switch enclosure shall be tamperproof.

- B. The detectors shall be furnished and installed by the Sprinkler Contractor and be wired complete by the Electrical Contractor to local fire district alarm service.

2.21 ELECTRIC ALARM: Electrically operated audio/visual horn and strobe device.

2.22 DRY PIPE VALVES

- A. Dry Pipe Valves: UL 260; differential type; 175-psig working pressure; with cast-iron flanged inlet and outlet, bronze seat with O-ring seals, and single-hinge pin and latch design. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

1. Option: Grooved-end connections for use with keyed couplings.
2. Dry pendent sprinklers shall be utilized where the dry-pipe system sprinklers are provided in the pendent position.
3. Provide pressure alarm switches.
 - a. Coordinate wiring of supervisory switches with the Electrical Contractor.
 - b. Electrical contractor shall wire supervisory switches the building fire alarm panel.

2.23 COMPRESSED AIR SUPPLY

- A. For dry-pipe systems, an air supply capable of restoring system pressure within 30 minutes shall be provided. Compressed air shall be provided by a tank-mounted oil less Q-Series (Quiet Series) air compressor, manufactured by General Air Products or approved equivalent. Provide vibration isolation pads at base of tank.
- B. Air-Pressure Maintenance Devices: Automatic device to maintain correct air pressure in piping. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig maximum inlet pressure.
- C. Air Compressor
 1. Fire protection contractor shall coordinate air compressor power requirements, including location, horsepower and voltage, with Electrical contractor.
 2. Electrical contractor shall verify with the fire protection contractor the location that the air compressor will be installed prior to installing power to air compressor.
 - a. Final location of air compressor shall be shown on the approved fire protection shop drawings
 3. Air compressor shall be UL Listed for use with fire protection systems.

- D. Quick-Opening Device - Provide a Listed quick-opening device where required to meet the 60 second delivery time per NFPA 13.
- E. Provide with a dry system accelerator and anti-flood system per NFPA13.

2.24 EXPANSION LOOPS

- A. Expansion Loops shall comply with the following:
 - 1. U bend design expansion loop equal to Metraloop as manufactured by the MetraFlex Company.

2.25 PIPE ALIGNMENT GUIDES

- A. Alignment guides shall be factory fabricated with split steel guiding cylinder with anchor case and split steel spider. Guiding cylinders shall be split at 45 degrees and shall be designed to accommodate specified insulation thickness. Allow 1/8" minimum clearance between I.D. of guiding cylinder and O.D. of insulation.
- B. Guides shall be equal to ADSCO Model E for steel piping. Equal guides by MetraFlex are acceptable.

2.26 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0 to 250 psig minimum.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION**3.1 FLOW TEST**

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations.
- B. Report test results with hydraulic calculations.

3.2 INSTALLATION OF FIRE PROTECTION SYSTEMS

- A. All items necessary for a working installation complete in every detail shall be furnished and installed whether specifically mentioned or not.
- B. Pipe sizes shown on drawings are minimum required pipe sizes only. Contractor shall provide pipe sizes required for a code compliant and fully functional system. Pipe sizes shall be determined by the contractor's hydraulic calculations and show on the contractors Shop Drawings.
- C. Sprinklers shall be located in a symmetrical pattern related to ceiling features such as grid, beams, light fixtures, diffusers, etc. and where applicable, heads shall be located symmetrically with the ceiling grid, centered in two directions. Locate heads to provide code required distances away from lights, exit signs, etc., and all other items that could interfere or effect sprinkler discharge.
- D. Apply temporary protective covers during construction to ensure that sprinklers and escutcheons do not receive field paint.
- E. Route piping in orderly manner, plumb and parallel to building structure and concealed above ceilings where possible. Locate concealed valves, switches and alarm connections in accessible location, and coordinate size and location of access panels/doors with General Contractor.
- F. Provide an electrically operated audio/visual horn and strobe device.
 - 1. At the building exterior, directly above the fire department connection.
- G. This Contractor's work shall extend to 5 feet beyond exterior wall.
- H. No work shall be concealed where it is inaccessible unless inspected and approved by the authorities having jurisdiction.
- I. Install piping to conserve building space and not interfere with use of space and other Work. Coordinate with other trades to avoid conflicts and provide all required offsets, piping, auxiliary drains, etc. to properly install system. Where piping installation conflicts with the installation of other trades during construction, piping shall be removed and re-routed at no additional cost.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
- K. Penetrations through fire rated walls, floors and partitions shall be sealed to provide a U.L. rating equal to or greater than the wall, floor or partition.
- L. Install sprinklers in lay-in ceilings with flexible connector or return bend. Sprinklers connected to the bottom of branch lines are not acceptable.
- M. Install an automatic air vent at the high point of the sprinkler system. Automatic air vent shall be installed in an accessible location. Contractor shall provide an access panel as required, labeled to note the location of the air vent for maintenance purposes. Coordinate with fire alarm contractor for wiring to the automatic air vent.
- N. Install drain piping at low points of piping system.

- O. Install drain risers as indicated and as required by NFPA 13.
- P. Install a main shut-off valve at the fire protection service entrance.
- Q. Install pressure gauges on both the inlet and outlet piping of backflow preventers.
- R. Mount supervisory switches on each shut-off valve.
- S. Electrical contractor shall wire supervisory switches the building fire alarm panel.
- T. Install Inspector's test connection where indicated, or at most remote point from riser.
- U. Provide a wall mounted fire department connection as required, including check valve with 1/2" automatic ball drip valve to serve sprinkler system.
- V. Sprinkler Piping Flushing: Prior to connecting sprinkler risers, flush water feed mains and lead-in connections.
- W. Piping is to be held as high as possible where exposed.
- X. Wet system pipe may be installed level as per NFPA 13.
- Y. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
- Z. Dry sprinkler assemblies shall be provided for dry systems, and shall be installed with return bend piping arrangement so that the dry pipe system can be fully drained after testing.
- AA. Provide return bends connected to the top of branch lines, or flexible sprinkler drops connected to the side of branch lines, to all pendent sprinklers as shown on drawing details. Sprinklers connected to the bottom of branch lines is not acceptable except for exposed pendent sprinklers located at the deck.
- BB. Provide identification sign for fire department connections, alarms, hydraulically designed systems, sectional valves, riser control valve, drain valves, test and drain connections in accordance with NFPA 13 and 72.

3.3 PIPING AND FITTINGS

- A. All piping shall be installed in accordance with good commercial practices.
- B. Fire seal all penetrations through fire rated assemblies per specification section 210010.
- C. Piping systems shall be securely supported by U. L. listed hangers with allowance for pipe expansion and contraction; agent thrust forces, and shall not be subjected to mechanical vibration or other damage. Consult ANSI B-31.1.0 for guidance on this matter. Hangers shall be spaced according to manufacturer's recommendations.
- D. Install building attachments within concrete or to structural steel. Piping shall not be supported from joist bridging or a roof metal deck.

- E. All pipe lengths shall be reamed, blown clear and swabbed with suitable solvents to remove butts, mill varnish and cutting oil before assembly.
- F. After cutting, pipe ends shall be thoroughly cleaned. Before installing nozzles, piping shall be blown out with dry air or dry nitrogen to ensure the system is free of debris.
- G. For threaded fittings, teflon tape dope only shall be used and applied to male pipe threads only.
- H. Install expansion loops at all building expansion joints. Refer to the architectural and / or structural drawings for all expansion joint locations and movement requirements.

3.4 TESTING

- A. The entire automatic sprinkler system shall be tested in the presence of an authorized representative of the Engineer and the governing agencies having jurisdiction for approval. Advance notice of 24 hours is required.
- B. The installing Contractor shall complete and sign the appropriate Contractor's Material and Test Certificates included within NFPA 13.
- C. All interior sprinkler piping shall be pressure tested hydrostatically at not less than 200 P.S.I. for two (2) hours. Hydrostatic testing shall be performed in accordance with NFPA 13. Interior sprinkler piping shall be installed in such a manner that there will be no visible signs of leakage or pressure drop for the duration of the hydrostatic pressure test.
- D. Hose Threads. All hose connection and fire department connection threads shall be tested to verify their compatibility with threads used by the local fire department. The test shall consist of threading coupling samples, caps, or plugs onto the installed devices.
- E. The Contractor's Material and Test Certificate as shown in NFPA 13 must be completed and submitted to the Engineer before final approval may be given.
- F. Preliminary testing procedures shall be conducted as mentioned above to assure proper operation when the final testing is performed.
- G. Dry-Pipe Testing: Test dry-pipe with air at pressures not less than 40 P.S.I., for a period of 24 hours. Check system for leakage. Leakage over 1.5 PSI for the 24 hour test period shall be corrected. Leave differential dry-valve clappers open during test, to prevent damage. Contractor shall remove and reinstall dry system piping until the dry system maintains 40~38.5 P.S.I. over a 24 hour period.
- H. Repair or replace piping system as required to eliminate leakage in accordance with NFPA standards and retest as specified to demonstrate compliance.

END OF SECTION 210500

SECTION 210511 – CLEAN AGENT FIRE EXTINGUISHING SYSTEM**PART 1 - GENERAL****1.1 SCOPE**

- A. This specification outlines the requirements for an “Engineered Total Flood” Clean Agent Fire Suppression System with automatic detection and control. The work described in this specification includes all engineering, labor, materials, equipment and services necessary, and required, to complete and test the suppression and detection system.
- B. System Operating Sequence: System shall be photoelectric detectors reporting to a fully programmable microprocessor-based Clean Agent Releasing Control Panel (RCP) programmed to operate as follows:
 - 1. First Detector Actuation (Alert) - Releasing Control Panel shall:
 - a. Initiate a mild audible and visual indication on annunciator panel.
 - b. Strobe lights shall flash slowly in the protected area.
 - c. Clean agent releasing panel to shut down power to CRAC unit(s).
 - 2. Second Detector Actuation (Action) - Releasing Control Panel shall:
 - a. Initiate a strong audible and visual indication on annunciator panel.
 - b. Strobe lights shall flash rapidly in the protected area.
 - c. Start 30 second time delay of clean agent system discharge.
 - d. Enable system abort pushbutton(s) at exit doors. Operating abort switch(es) shall delay discharge while depressed.
 - 3. Third Level (Discharge) - Following expiration of the time delay the RCP shall:
 - a. Initiate a strong audible and visual indication on annunciator panel.
 - b. Discharge extinguishing agent.
 - c. Operate strobe lights inside the protected area and outside entry doors.
 - d. Terminate power to building UPS.
- C. The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time-delay and abort functions SHALL be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main Releasing Control Panel.

1.2 RELATED SECTIONS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 210000 – Fire Protection General Conditions
- C. Section 210010 - Basic Fire Protection Material and Methods
- D. Section 210030 – Vibration and Seismic Controls for Fire Protection Piping and Equipment.

E. Division 26 – Electrical

1.3 APPLICABLE STANDARDS AND PUBLICATIONS

- A. The design, equipment, installation, testing and maintenance of the Clean Agent Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards:

1. NFPA 2001 – Clean Agent Fire Extinguishing Systems
2. NFPA 70 – National Electrical Code
3. NFPA 72 – National Fire Alarm Code
4. U.L. Listings
5. Requirements of the Authority Having Jurisdiction (AHJ)

- B. The Standards listed, as well as all other applicable codes and standards, shall be used as “minimum” design standards. Also to be considered are the requirements of the “Authority Having Jurisdiction” and good engineering practices.

1.4 REQUIREMENTS

- A. The Suppression System installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail.

- B. Related Documents:

1. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
2. Section 210000 - Fire Protection General Conditions
3. Section 210010 - Basic Fire Protection I Materials and Methods
4. Section 210020 - Fire Protection Vibration Isolation and Seismic Restraints
5. Section 260010 - Basic Electrical Material and Methods

1.5 EXCLUSIONS

- A. The work listed below shall be provided by others, or under other sections of this specification:

1. Provide drawings and other detailed design documents signed and sealed by a Professional Engineer registered in the state.
2. 120 VAC power supply to the system control panel.
3. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.
4. Connection to local/remote fire alarm systems, including any required fire alarm programming, equipment or testing.

1.6 QUALITY ASSURANCE

- A. Manufacturer:

1. The manufacturer of the Suppression System hardware and detection components shall have a minimum of 10 years experience in the design and manufacture of similar types

of suppression systems and who refer to similar installations providing satisfactory service.

2. The name of the manufacturer, part numbers and serial numbers shall appear on all major components.
3. All devices, components and equipment shall be the products of the same manufacturer.
4. All devices, components and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.
5. All devices and equipment shall be U.L. listed and/or FM approved.
6. Locks for all cabinets shall be keyed alike.

B. Installer

1. The installing contractor shall be trained by supplier to design, install, test and maintain Suppression Systems.
2. The installing contractor shall employ a NICET certified special hazard designer, level 3 or above, who will be responsible for this project.
3. The installing contractor shall be an experienced firm regularly engaged in the installation of automatic Clean Agent, or similar, fire suppression systems in strict accordance with all applicable standards.
4. The installing contractor must have a minimum of five (5) years experience in the design, installation and testing of Clean Agent, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.
5. The installing contractor shall show evidence that his company carries a minimum \$1,000,000.00 liability and completed operations insurance policy.
6. The installing contractor shall maintain, or have access to, a Clean Agent recharging station. The installing contractor shall provide proof of his ability to recharge the largest Clean Agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.
7. The installing contractor shall be an authorized stocking distributor of the Clean Agent system equipment so that immediate replacement parts are available from inventory.
8. The installing contractor shall show proof of emergency service available on a twenty-four hour, seven-day-a-week basis.

C. Submittals

1. General: Submit the following in accordance with Section 210000.
2. Product data including weights, dimensions, metal gauges, and data on features and components. Include plan and elevation views of units, minimum clearances, and data on ratings and capacities.
3. Data for inclusion in Operating and Maintenance Manual specified in Section 210000.
4. The installing contractor shall submit the following design information and drawings for approval prior to starting work on this project:
 - a. Field installation layout drawings having a scale of not less than 1/8" = 1'-0" detailing the location of all agent storage tanks, pipe runs including pipe sizes and lengths, control panel(s), detectors, manual discharge stations, abort stations, audible and visual alarms, etc.
 - b. Auxiliary details and information such as maintenance panels, door holders, special sealing requirements and equipment shutdowns.

- c. Separate layouts, or drawings, shall be provided for each level, (i.e.; room, under-floor, and above ceiling) and for mechanical and electrical work.
 - d. A separate layout or drawing shall show isometric details of agent storage containers, mounting details and proposed pipe runs and sizes.
 - e. Electrical layout drawings shall show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.
 - f. Provide an internal control panel-wiring diagram, which shall include power supply requirements and field wiring termination points.
 - g. Electrical wiring diagrams detailing power, control, initiation, notification and trouble wiring required for field installation.
 - h. Graphic Annunciator wiring schematics and dimensioned display panel illustration shall be provided.
 - i. Complete hydraulic flow calculations, from a U.L. listed computer program, shall be provided for all engineered Clean Agent systems. Calculation sheet(s) must include the manufactures name and U.L. listing number for verification. The individual sections of pipe and each fitting to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.
 - j. Provide calculations for the battery stand-by power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.
 - k. A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operations, time delay and agent discharge for each zone or system.
5. Submit signed and sealed drawings, calculations and system component data sheets for approval to the local Fire Prevention Agency, owner's Insurance Underwriter and all other Authorities Having Jurisdiction before starting installation. Submit approved plans to the Architect/Engineer for record.

D. Operation and Maintenance

- 1. Prior to final acceptance, the installing contractor shall provide compete operation and maintenance instruction manuals, four (4) copies for each system, to the owner. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawings illustrating control logic and equipment used in the system. Submittal documents, checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

E. As-Built Drawings

- 1. Upon completion of each system, the installing contractor shall provide four (4) copies of system "As-Built" drawings to the owner. The drawings shall show actual installation details including all equipment locations (i.e. control panels, agent container(s), detectors, alarms and manuals and aborts, etc) as well as piping and conduit routing

details. Show all room or facilities modifications, including door and/or damper installations completed. One (1) electronic PDF file shall be provided on CD disk.

F. Warranty

1. All system components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION AND OPERATION

- A. The system shall be an FK-5-1-12 Suppression System by Fike, 3M, or Kidde.
- B. The FK-5-1-12 system shall provide a minimum design concentration as published by the agent manufacturer, in all areas and/or protected spaces, at the minimum anticipated temperature for a minimum 10-minute holding time within the protected area. System design shall not exceed the NOAEL value of 10%, adjusted for maximum space temperature anticipated, unless provisions for room evacuations, before agent release, are provided.
- C. Provide two (2) inspections during the first year of service. Inspections shall be made at 6-month intervals commencing when the system is first placed into normal service.
- D. The general contractor shall be responsible for sealing and securing the protected spaces against agent loss and/or leakage during the 10-minute "hold" period.
- E. The system(s) shall be actuated by a smoke detectors with sampling points installed at a minimum spacing of 250 sq. ft. per sampling point, in both the room, under-floor and above ceiling protected spaces.
- F. Smoke Detector Alarm outputs shall be wired in "Sequential Detection" method of operation for release, using Class "B" wiring arrangement. No other detection / wiring arrangements will be acceptable.

2.2 MATERIALS AND EQUIPMENT

- A. General Requirements: The Clean Agent System materials and equipment shall be standard products of the supplier's latest design and suitable to perform the functions intended. When on or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one manufacturer.
 1. All devices and equipment shall be U.L. Listed and/or FM approved.
- B. Storage and Distribution: Each system shall have its own supply of clean agent.
 1. The system design can be modular, central storage, or a combination of both design criteria.
 2. Systems shall be designed in accordance with the manufacturer's guidelines.

3. Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.
4. The clean agent shall be stored in cylinder type Agent Containers. Container shall be super-pressurized, with dry nitrogen, to an operating pressure of 360 psi @70 F. Containers shall be of high-strength alloy steel construction and conform to NFPA 2001.
5. Parallel-wired initiators, through an Agent Release Module located at each agent container, shall actuate containers.
6. Each container shall have a pressure gauge and low-pressure switch to provide visual and electrical supervision of the container pressure. The low-pressure switch shall be wired to the control panel to provide an audible and visual "Trouble" alarm in the event the container pressure drops below 272 psi. The pressure gauge shall be color coded to provide an easy, visual indication of container pressure.
7. Each container shall have a pressure relief provision that automatically operates when the pressure at 150°F exceeds the ASME rated maximum allowable working pressure (MAWP).
8. Engineered discharge nozzles shall be provided, within the manufacturers guidelines, to distribute the agent throughout the protected spaces. The nozzles shall be designed to provide proper agent quantity and distribution.
 - a. Nozzles shall be available in pipe sizes 3/8" thru 2".
 - b. Nozzles shall be available in 180° and 360° distribution patterns.
 - c. Ceiling plates shall be used to conceal pipe entry holes through ceiling tiles.
 - d. Nozzles orifice sizes shall be designed to discharge a maximum of 25 lbs/sec.

2.3 ELECTRICAL REQUIREMENTS

A. Releasing Control Panel (RCP)

1. The control panel shall be a single hazard control system.
2. The Control System, and its components, shall be UL listed and FM approved for releasing service.
3. The Control System shall perform all functions necessary to operate the system detection, actuation and auxiliary functions, as outlined.
4. The Control System shall be capable of providing sufficient capacity battery standby power supplies, integral to the panel. **Batteries shall be capable of operating the system for 24 hours followed by 15 minutes in alarm mode.**
5. The Control System shall be microprocessor based with hardware and software integration designed to guarantee reliability.
6. The Control System shall support Sequential release and Manual Release detection/actuation methods.
7. The Control System shall provide the following capabilities and functions:
 - a. Two (2) Class B (Style Y) notification appliance circuits rated for 2.0 amps @24 VDC.
 - b. Two (2) Class B (Style B) initiating circuits.
 - c. Two (2) Class B (Style 4) signal line circuits.
 - d. Eight (8) Status LED's plus alphanumeric display for troubleshooting: AC normal; alarm; pre-discharge; release; supervisory; trouble; alarms silenced and system abort.

- e. Programmable pre-discharge and discharge timers.
- f. Resettable and continuous auxiliary output power rated 4 amps at 24 VDC for notification appliances.
- g. Five (5) optional Abort types.
- h. Intelligent Transistor protection to prevent noise spikes and microprocessor failure from inadvertently activating release outputs.
- i. A dedicated Disarm switch for release outputs.
- j. Dedicate alarm and trouble contacts programmable for alarm, trouble, pre-discharge, discharge, abort, and supervisory or water-flow functions, depending on panel configuration.
- k. Supplementary Relay Module providing four (4) additional programmable 5 amp relays.
- l. Provide connections to Fire Alarm Monitor Modules for RCP trouble and alarm, for each RCP zone.
- m. Panel shall be available in either Red or Gray finish.

B. Detectors

1. General Requirements for System Smoke Detectors:

- a. Comply with UL 268, NFPA 72 and NFPA 2001; operating at 24-V dc, nominal
- b. Detectors shall be two-wire type.
- c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- d. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
- e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- f. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

2. Photoelectric Smoke Detectors:

- a. Detector address shall be accessible from the releasing control panel and shall be able to identify the detector's location within the system and its sensitivity setting.
- b. An operator at the releasing control panel , having the designated access level, shall be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).

C. Manual Discharge (Electric)

1. The electric manual discharge station shall be a dual action device, which provides a means of manually discharging the Suppression System when used in conjunction with the releasing control system.
 - a. The Manual Discharge Station shall be a dual action device requiring two distinct operations to initiate a system actuation.
 - b. Manual actuation shall bypass the time delay and abort functions, shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
 - c. A Manual Discharge Station shall be located at each exit from the protected hazard and shall have an advisory sign, provided at each location.
 - d. Connect the manual discharge station to the releasing control panel via a control module.

D. Abort Station

1. Abort Station shall be the "Dead Man" type and shall be located next to each manual switch. The abort station and manual discharge station can be a combination device installed on a single box.
 - a. The Abort Station shall be supervised and shall indicate a trouble condition at the releasing control panel if operated when no alarm condition exists.
 - b. "Locking" or "Keyed" abort stations shall not be permitted.
 - c. The Abort Station shall be located adjacent to each manual station and shall have an advisory sign, provided at each location.
 - d. Connect the abort station to the releasing control panel via a control module.

E. Audible and Visual Alarms

1. Alarm audible and visual devices shall operate from the releasing control panel.
 - a. A Bell device shall be installed within the protected hazard(s). The Alarm Bell, 24VDC, shall be provided with a 6" shell, and operate during the "DISCHARGE" fire level.
 - b. Horn/Strobe combination shall be installed adjacent to the alarm bell within the protected hazard, designed to operate during the first detector activation or "ALERT AND ACTION" fire levels. Strobe light shall meet minimum ADA requirements with 15/75candela output.
 - c. A Strobe device shall be placed outside, and above, each exit door from the protected space. Strobe light shall operate during the "DISCHARGE FIRE" Level.
 - d. "AGENT" labels shall be attached to all strobe lenses.

2.4 CAUTION AND ADVISORY SIGNS

- A. Provide engraved plastic signs, as required, to comply with NFPA 2001 and the recommendations of the equipment supplier. Signs shall be high gloss, scratch and UV resistant.
 1. Entrance Warning Sign: (1) required at each entrance to a protected space.
 2. Exit Warning Sign: (1) required at each exit to a protected space.

3. Manual Discharge Sign: (1) required adjacent to each manual discharge station.
4. System Abort Sign: (1) required adjacent to each abort station.
5. Alarm Bell sign: (1) required adjacent to each alarm bell.
6. Pre-discharge Horn/Strobe sign: (1) required adjacent to each horn/strobe.
7. Discharge Strobe sign: (1) required adjacent to each discharge strobe.
8. Maintenance Caution sign: (1) required adjacent to each Agent Release Disconnect Switch.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines.
- B. All piping shall be installed in accordance with good commercial practices.
- C. Piping systems shall be securely supported by U. L. listed hangers with allowance for pipe expansion and contraction; agent thrust forces, and shall not be subjected to mechanical vibration or other damage. All piping shall be adequately supported and anchored at all directional changes and nozzle locations. Hangers shall be spaced according to manufacturer's recommendations.
- D. Install building attachments within concrete or to structural steel. Piping shall not be supported from joist bridging or a roof metal deck.
- E. After cutting, pipe ends shall be thoroughly cleaned, reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oil before assembly. Before installing nozzles, piping shall be blown out with dry air or dry nitrogen to ensure the system is free of debris.
- F. For threaded fittings, teflon tape shall be applied to male pipe threads.
- G. Penetrations through fire rated walls or floors shall be sealed with an approved fire stopping compound to maintain the fire resistance rating of the wall or floor.
- H. Install suppression agent containers properly anchored per seismic criteria.
- I. Fill suppression agent containers and pressurize to require charging pressure.

3.2 SYSTEM AND CONTROL WIRING

- A. All system wiring shall be furnished and installed by the contractor.
 1. All wiring shall be installed in electric metallic tubing (EMT), or conduit, and must be installed and kept separate from all other building wiring.
 2. All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, installed parallel and perpendicular to walls and partitions.
 3. The sizes of the conductors shall be those specified by the manufacturer. Color-coded wire shall be used. All wires shall be tagged at all junction points and shall be free from

shorts, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the releasing control panel and the system field wiring shall be made under the direct supervision of a factory trained representative.

4. All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the National Electrical Code, Article 725, and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72- Current Edition. Wiring installation shall meet all local, state, province and/or county codes.
5. The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

3.3 SYSTEM INSPECTION AND CHECKOUT

- A. After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA Standards.
 1. All containers and distribution piping shall be checked for proper mounting and installation.
 2. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.
 3. The complete system shall be functionally tested, in the presence of the owner or his representative, and all functions, including system and equipment interlocks, must be operational at least five (5) days prior to the final acceptance tests.
 - a. Each detector shall be tested in accordance with the manufacturer's recommended procedures, and test values recorded.
 - b. All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.
 - c. Each releasing control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

3.4 TRAINING REQUIREMENTS

- A. Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owners personnel. Each training session shall include system Releasing Control Panel Operation, manual and abort functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

3.5 ACCEPTANCE TESTS

- A. At the time "As-Built" drawings and maintenance/operations manuals are submitted, the installing contractor shall submit a "Test Plan" describing procedures to be used to test the control system(s).
 1. The test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed.

2. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the owner and shall not be conducted until the Test Plan has been approved.
3. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.
4. A room pressurization test shall be conducted, in each protected space, to determine the presence of openings that would affect the agent system concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA 2001, Appendix B.
5. If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. The Suppression System Installing Contractor shall be responsible for the success of the room pressurization tests.
6. If the first room pressurization test is not successful, in accordance with these specifications, the installing contractor shall direct the general contractor to determine, and correct, the cause of the failure. The installing contractor shall conduct additional room pressurization tests, at no additional cost to the owner, until a successful test is obtained. Copies of successful test results shall be submitted to the owner for record.
7. Upon acceptance by the owner, the completed system(s) shall be placed into service.

3.6 SYSTEM INSPECTIONS

- A. The installing contractor shall provide two (2) inspections of each system, installed under this contract, during the one-year warranty period. The first inspection shall be at the six-month interval, and the second inspection at the 12 month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer's guidelines and the recommendations of NFPA 2001.
- B. Documents certifying satisfactory system(s) operation shall be submitted to the owner upon completion of each inspection.

END OF SECTION 210511

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DIVISION 22 – PLUMBING

220000	Plumbing General Conditions
220010	Basic Plumbing Materials and Methods
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220430	Domestic Water Softeners
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SECTION 220000 – PLUMBING GENERAL CONDITIONS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 220000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The plumbing work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- E. It shall be a part of this Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.
- F. Rough-in for and connect, as shown on the drawings, facilities for equipment furnished by the Owner under a separate contract.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes:

Kentucky State Building Code - 2018
Kentucky State Plumbing Code - 2022
Kentucky State Mechanical Code - 2015
Kentucky State Fuel Gas Code - 2015
Kentucky State Fire Prevention Code - 2015
Kentucky State Energy Conservation Code - 2012
National Electrical Code - 2023

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or

shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every respect. Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.

- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this Contractor. Piping, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all pipe, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as pipe arrangement, fittings, specialties, etc., which are not shown on the plan view. This Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.
- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.

- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. This Contractor, before submitting his bid, shall visit the site and thoroughly acquaint himself with conditions under which the work will be performed.
- B. Failure to fully acquaint himself with existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract. See General Conditions for additional requirements.

1.7 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations.

1.8 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General and Special Conditions. Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to:

SSC Engineering
Attention: Submittals
18207 Edison Ave.
Chesterfield, MO 63005
 - 4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".
- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the

Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's sole use. The Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the Contractor marked accordingly.

- E. If SSC is the prime consultant and there is no Architect, paper documents shall be transmitted directly to SSC.
- F. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- G. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
- H. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this Contractor.
- I. Shop drawings shall include the plan mark used on the plans.
- J. Valve and fitting shop drawings shall indicate the intended service.
- K. Equipment shop drawings shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- L. Submittals which do not provide the required information will be returned unchecked.
- M. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- N. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- O. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

1.9 RELEASE OF CAD FILES

- A. See "Release of Cad Files" at the end of this section.

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- B. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - 2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- C. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
- D. Contractor shall also submit four (4) complete hard copy sets and one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
 - 1. Complete set of shop drawings.
 - 2. Copies of all submittals.
 - 3. Parts lists, wiring diagrams, piping diagrams, etc.
 - 4. Manufacturers' operating and maintenance instructions.
 - 5. As-built drawings.
 - 6. Written operating and maintenance instructions for the system.
 - 7. Copies of warranties.
 - 8. Parts list for each piece of equipment and name of local supplier.
- E. At a predetermined time, prior to building occupancy, an instructional session shall take place. The installing contractors and major suppliers shall instruct the Owner's operating personnel on operation and maintenance of the systems. The installing Contractor shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.11 RECORD DRAWINGS

- A. During construction, a separate set of plans at the jobsite shall be maintained by the Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.

- B. Locations of piping, specialties and other concealed facilities are to be shown by the Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the contractor in CAD format, contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 WORKMANSHIP AND MATERIALS

- A. All work shall be performed in a manner acceptable to the Engineer, Architect, and the Owner, by properly trained, supervised and experienced personnel using new and clean materials, supplies, equipment, and hardware.

1.13 MATERIAL AND EQUIPMENT HANDLING AND STORAGE

- A. It is recognized that space at the project for storage of materials and products is limited. Coordinate the deliveries of materials and products with the scheduling and sequencing of the work so that storage requirements at the project are minimized. In general, do not deliver individual items of equipment to the project substantially ahead of the time of installation.

1.14 GUARANTEE AND WARRANTY

- A. This Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year from final acceptance in accordance with the General Conditions.
- B. During the guarantee period, this Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required during this period at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.

- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this Contractor's bid. This contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.
- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.
- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall furnish all material, equipment, labor, services, supplies, etc., required to execute to completion all work shown on the plumbing drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. This Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, this Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. If this Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, this Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall furnish and install all power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be furnished and installed by the Electrical Contractor. Unless noted otherwise, the control wiring shall be furnished and installed by the Contractor furnishing the controlled equipment.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. This Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This Contractor shall cooperate with and coordinate with the Owner's Representative to plan and schedule the work to satisfy the schedule.
- B. All work shall be so arranged that electrical power, sewer, water, and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.
- C. All interruptions shall be scheduled, and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.
- D. Pipes which are shown to be installed or demolished in subsequent phases that are needed for earlier phases to make the earlier phase operational shall be installed or demolished in the earlier phase during non-business hours. Where later phase work is performed in an earlier phase, contractor shall remove and replace ceilings as required to perform the work.

3.5 DEMOLITION OF FACILITIES

- A. General
 - 1. The demolition work shall consist of removal of plumbing equipment and related piping pertaining to the installation and modifications of the plumbing systems as indicated on the drawings.
 - a. Piping to Be Removed: Drain piping and remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 2. Contractor shall note the project is a renovation to an existing building. The building shall remain in operation at all times during the construction. Contractor shall allow adequate overtime and supervision to allow for work that is required by the owner to be performed after normal operating hours.
 - 3. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. The Contractor shall be responsible to field verify actual

existing conditions and remove all items, whether indicated on drawings or not, as required for new work.

4. Contractor shall review the drawings, specifications and existing job conditions and shall include in his bid all demolition work as required and as shown on the plumbing drawings.
5. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
6. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.
7. All plumbing equipment to be reused shall be disconnected, marked and protected where necessary.

B. Existing Conditions

1. Contractor shall exercise great caution when performing demolition work to prevent damage to existing systems or items of work that are to remain. If Contractor damages, removes or destroys an existing system which is to remain, Contractor shall repair or replace that system to its original condition.
2. Unless specifically stated otherwise on the plans, where access to plumbing items is required, Contractor shall provide the required access by removing ceilings, cutting openings, etc., as required. Prior to cutting openings, this Contractor shall outline the openings and shall obtain approval from and shall cut openings in the manner directed by the Owners Representative and General Contractor. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.
3. Repair of openings is a part of this Contractor's work. Work shall be performed by the proper trades. Materials which are removed, damaged, or soiled shall be replaced with new materials. Ceilings and walls shall be repaired and restored to as close to the original condition as possible. This shall include replacement of surface finish materials such as paint, plaster, drywall, ceiling tile, etc.
4. Repair of floor openings and trenches is a part of this Contractor's work. Floors shall be repaired to match the level and surface finish of the existing concrete and flooring finishes.
5. Areas shall be repaired with materials matching those which have been removed.
6. Contractor shall repair streets, sidewalks, parking lots and reseed grassed areas which have been altered by his work.

C. Protection

1. During demolition operations, all persons and property shall be protected. This Contractor shall be responsible for the erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.
2. Contractor shall minimize any spread of dust, debris and flying particles. Demolition shall not interfere with the surrounding equipment, personnel, or buildings.

3. Where necessary, this Contractor shall provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. Disposition of Material

1. Those items of material and equipment to be removed by this Contractor and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

E. Hazardous Materials

1. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work. Hazardous materials will be removed by Owner before start of the Work. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect, Engineer, and Owner. Owner will remove hazardous materials under a separate contract.
2. Where insulation containing hazardous materials is removed from piping and equipment, it shall be replaced with new insulation. See specification 220400, Plumbing Systems.

3.6 MAINTENANCE OF WORK AREAS

- A. During the project this Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.
- B. Open ends of pipe, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.7 CLEANING AND CLEANUP

- A. Upon completion of this work, the Contractor shall clean all pipe, fixtures, and equipment. Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. This contractor shall be responsible for his own cleanup to a central location designated by the Owner and General Contractor. Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work.

END OF SECTION 220000

RELEASE OF CADD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2023. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CADD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

Company

Version of AutoCAD used

Name (Must be an officer of the Company)

E-mail address

Title

Maximum e-mail attachment size

Date

SECTION 220010 - BASIC PLUMBING MATERIALS AND METHODS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. This section covers basic plumbing materials and methods for Plumbing work and applies to work of those sections.

1.2 SUBMITTALS

- A. This Contractor shall submit shop drawings on all material or equipment furnished by him or his Subcontractors. Manufacturer's technical product data and installation instructions shall be submitted on:
 - 1. All Supports
 - 2. Pipe Seals and Pipe Stands
 - 3. Sealants
 - 4. Pipe Markers

PART 2 - PRODUCTS**2.1 PRODUCT CRITERIA**

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers

ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association
HEW	U.S. Department of Health, Education and Welfare
PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation
IEEE	Institute of Electrical and Electronic Engineers
AWWA	American Water Works Association

- C. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

2.3 PREFABRICATED PIPE SEALS

A. Seals for Roof Penetrations:

1. Prefabricated pipe seals shall have a one piece spun aluminum base with a 5" high roof surface flange sloped for runoff. Unit shall have a PVC boot with graduated widths and adjustable stainless steel clamps. Unit shall withstand expansion, and vibration and shall fit pipe sizes from ½" through 10" be heavy-gage, galvanized steel curb with mitered and welded corners; 1-1/2-inch-thick
2. Equal products, complying with these specifications by the following manufacturers are acceptable:
 - a. Pate
 - b. Roof Products & Systems
 - c. Thycurb
 - d. Approved Equal

B. Seals for Floor or Foundation Wall Penetrations:

1. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

2.4 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- C. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.
- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.6 SLEEVES

- A. Exterior and Foundation Walls: All piping through exterior or foundation walls shall pass through schedule 40 galvanized steel sleeves which shall be large enough to allow for caulking material. No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved by the Engineer.
- B. Interior Walls and Partitions: All piping through interior walls and partitions that are fire rated shall pass through either schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves. Schedule 40 steel pipe sleeves must be used when required for structural purposes. Sleeves are not required for automatic control tubing.
- C. Floors: All piping through elevated floor slabs shall be provided with schedule 40 carbon steel pipe sleeves, extending 2 inches above floor except in finished areas. Sleeves in finished areas shall terminate flush with floor, and shall be schedule 40 carbon steel pipe.

2.7 BACKING & SEALANTS

- A. Backing and sealant for piping passing through floors, plaster ceilings, partition, and walls shall be as follows:
 - 1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
 - 2. Sealant: Gun Grade. A 1-part modified polyurethane, gun applied, elastic sealant, "Dymonic" by Tremco, or Chem-Calk 900 by Bostik.
 - 3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.
 - 4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following:
 - a. "SpecSeal" by Specified Technologies Inc.
 - b. 3M
 - c. Chase Technology Corporation
 - d. Link-Seal

- e. Pyro-Pac by Thunderline Corporation
- f. "Fyre Seal" by Tremco
- g. Pensil 100 by General Electric
- h. Pensil by STI
- i. "Flameseal" by G. S. Nelson Electric.

2.8 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.9 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, equipment, etc., shall be furnished and installed by this Contractor.
- B. Lintels furnished shall be structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.10 CUTTING

- A. All openings for pipes etc., shall be provided by this Contractor by means of sleeves or framed openings.
- B. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., this contractor shall obtain the Owner's approval in advance of the cutting and patching.
- C. Contractor shall be responsible for any cutting required for pipes, etc., if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.
- D. Prior to cutting or core drilling of structural concrete slabs, contractor shall locate steel reinforcing bars using x-ray or other approved methods. Location of holes shall be adjusted to locations that will not damage reinforcing bars; coordinate locations with the Structural Engineer.
- E. Where trenches are cut in the floor slab that contains structural reinforcing, reinforcing bars in the floor shall NOT be saw cut flush with the edge of the trench. See details on the structural drawings for retaining stubs of reinforcing bars (in both directions where this occurs) so they may be repaired and reinstalled as detailed by the structural engineer OR if not detailed on the structural drawings, contact the Structural Engineer before cutting begins to determine the course of action.
- F. Concrete for patching trenches in the floor slab shall be in accordance with Section 033000 (do not use the concrete specification in this section for patching structural concrete floor trenches.)

2.11 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching.
- C. Surfaces with finishing materials such as tiled, paneled, stone or marble surfaces - Patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching.

2.12 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be Allen Systems, Inc., W.H. Brady Co.- Signmark Div., or Industrial Safety Supply Co., Inc.
- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.
- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high letters. Provide 5/32" hole for fastener. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for proper attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name and plan number, 2) Equipment service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.13 UNDERGROUND PIPING MARKERS

- A. Tape: Triple-laminate, consisting of aluminum foil, polyester film, and polyethylene, 6" wide.
- B. Colored background, black lettering, two lines wide, and 2" tall letters. Provide different color tape for each piping service.
- C. Acceptable Manufacturer, subject to compliance with requirements: Panduit Corporation.

2.14 CEMENT GROUT

- A. Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

2.15 CONCRETE

A. Reinforcing Materials

1. Reinforcing and Joint Dowel Bars: Deformed steel bars, ASTM A 615, Grade 40, unless otherwise indicated. Furnish metal expansion caps for one end of each dowel bar. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1" unless otherwise indicated.
2. Welded Wire Mesh: Welded plain cold-drawn, ASTM A 185. Furnish in flat sheets, not rolls.

B. Concrete Materials

1. Portland Cement: ASTM C 150, Type II with tricalcium aluminate content of less than 5%.
2. Coarse aggregate shall be clean, hard, durable, uncoated limestone conforming to ASTM C-33. Use size "67" throughout with no more than one percent flint and chert by weight (i.e., when the amount of flint and chert are added together, this quantity shall be less than 1% of the coarse aggregate weight).
3. Water: Potable.
4. Air-Entraining Admixture: ASTM C 260.
5. Water-Reducing Admixture: ASTM C 494, Type A.
6. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

C. Proportioning and Design of Mixes

1. Prepare design mixes for concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility for preparing and reporting proposed mix designs. The testing facility may be the same as used for field quality control testing.
2. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
3. Design mixes to provide normal weight concrete with the following properties:
 - a. 4000 psi 28-day compressive strength.
 - b. 4,500 psi 28-day compressive strength at exterior locations where snow maintenance will be utilized.
4. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures

1. Use air-entraining admixture. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:

- a. Interior 2 - 4%.
 - b. Exterior 4.5 – 7.5%.
- 2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
- E. Slump Limits
 - 1. Proportion and design mixes to result in concrete slump at point of placement at not less than 2" and not more than 4".

2.16 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall furnish and install all bases, concrete inserts, anchor bolts, and structural steel to support the equipment, piping, etc., furnished and installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Provide concrete housekeeping pads a minimum of 3-1/2" high, unless detailed otherwise, under all equipment, heaters, tanks, etc., in the equipment rooms where piping containing water is located. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be ½" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood

grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment.

3.2 PIPE PROTECTION DURING CONSTRUCTION

- A. Protect pipe interiors with plastic plugs or plastic sheeting during construction to protect from moisture, construction debris and dust, and other foreign materials.

3.3 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

- A. This Contractor shall ascertain from his examination of the architectural and structural drawings whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary.
- B. The Contractor shall pay all cost of making such openings or providing such supports.

3.4 CUTTING AND PATCHING

- A. All cutting that may be necessary for the installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut.
- B. No openings shall be cut without written approval of the Owner's Representative.

3.5 ROOF PENETRATIONS

- A. Any penetration of the roof shall be provided with an appropriate roof penetration apparatus as herein described.
- B. Penetrations of ICC 500 rated roofs require rated device.
- C. Cutting of the metal decking for all unframed openings is the responsibility of the Contractor requiring the opening. Cutting, patching and flashing of roof shall be the responsibility of the Contractor needing the opening. Roof cutting and patching shall be coordinated with the roof installer. The original roof warranty shall be maintained.
- D. When penetrations occur in new roofs, the installation of the roofing materials to the connection and the waterproofing of the roofing at the roof penetration apparatus shall be by the General Contractor.
- E. When penetrations occur in an existing roof, the penetrations shall be made in the presence of the Owner, roof installer or General Contractor. If the penetration reveals any indication of wet or damaged roof, insulation, subroof or structure, all roof work by this contractor shall stop and the Owner shall be notified in writing as to the conditions found.
- F. At all times during construction, this Contractor shall provide temporary covers, enclosures, etc., required at roof openings to prevent injury to personnel and to prevent outdoor elements (water, wind, etc.) from entering the opening.

3.6 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.7 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor requiring access shall provide access panels.
- C. Contractor shall not provide access panel to equipment above drywall ceilings without written permission of Architect/Engineer.

3.8 PAINTING

- A. All pieces of plumbing equipment shall be factory finished machinery-grey, or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.
- B. This Contractor shall paint the following items:
 - 1. Items specified under "Demolition and Restoration of Facilities", Section 220000 shall be painted.
 - 2. All uninsulated piping installed outdoors shall be painted, primer plus one coat enamel, color selected by owner.
 - 3. No other painting is required unless specifically called for on the plans.

3.9 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves in foundation walls or footings shall be as detailed on the plans.
- C. Sleeves through floors shall extend 2" above finished floors.
- D. Sleeves in foundation walls or footings shall be as detailed on the plans. No sleeves, other than those shown on the drawings, shall be installed through footings or foundations without obtaining approval from the Structural Engineer.
- E. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. Sleeves shall be grouted in place.
- F. Where pipes pass through existing foundation walls or concrete walls below grade, the hole shall be core drilled.

- G. Where pipes pass through fire walls, plaster or drywall shall be applied around the outside of the sleeve to seal between sleeve and wall.
- H. The internal diameter of sleeves shall be 1" to 2" larger in diameter than the outside diameter of the pipe or pipe insulation. Insulation shall be continuous through sleeve.
- I. The space between the pipes and sleeves shall be sealed as follows:
 - 1. Exterior walls above grade: Caulking shall be applied to a minimum 3" total depth. Sealant shall then be applied on both sides of the wall opening to a minimum ½" in depth, finishing flush with the wall.
 - 2. Exterior walls below grade: The space between the pipe and the core drilled hole or sleeve shall be completely filled. Provide mechanical seal and install in accordance with manufacturer's instructions.
 - 3. Openings in floors or roofs: Caulking shall be applied from the upper side to a minimum depth of 3" recessed ½" below the finished floor or roof. This ½" recess shall then be filled with sealant to flush with finished floor or roof.
 - 4. Interior Non-Rated Walls/Partitions:
 - a. Concealed locations: Limit the size of the space between the wall and the outside of the pipe to 1" maximum. The space between the duct or pipe and the wall may be left open.
 - b. Visible Locations: Openings between pipe and wall shall be covered with a chrome plated escutcheon.
 - 5. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:
 - a. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.), the pipes shall be sealed per approved methods to meet U.L. Classifications, see the details on the drawings.
- J. Shop drawings shall be submitted on all fire resistant materials and methods.

3.10 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:
 - 1. Adjacent to each valve.
 - 2. At each branch or riser take-off.
 - 3. Where piping goes through floors, walls or ceilings.
 - 4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.
- B. All color coding shall comply with ANSI A13.1 1975.
- C. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.
- D. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each

tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.

- E. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and plan number and B) Equipment service, matching terminology on schedules as closely as possible.

3.11 LINES AND GRADES

- A. This Contractor shall set all construction stakes required for establishing the lines and grades for underground piping and equipment. He shall assume full responsibility for dimensions and elevations measured from such stakes and reset all stakes displaced or moved while the work is in progress.
- B. This Contractor shall coordinate all elevations and dimensions shown on the drawings with the General Contractor and other subcontractors and report any discrepancies to the Engineer. No work shall be installed until all discrepancies have been resolved.

3.12 EXCAVATION

- A. Excavate, as necessary, for all underground piping as indicated on drawings and/or necessary.
- B. Material to be excavated shall be nonclassified and shall include all earth or other materials encountered. The contract price shall cover the removal of all such material to the depth and extent indicated on the drawings and/or herein specified.
- C. Unless otherwise shown, provide separate trenches for each utility. Lay all piping in open trench except when the Engineer gives written permission for tunneling.
- D. Excavation of trenches from surface to top of pipe shall be kept to a minimum but shall be of sufficient width for proper installation of the work. The excavation from bottom of trench to top of pipe shall be not more than twenty (20) inches wider than the outside diameter of the pipe to be laid therein, or where depth of backfill over pipe exceeds ten (10) feet, width of trench at top of pipe shall not exceed 4/3 of nominal diameter of pipe, plus eight inches. For larger pipe, the bottom of trench shall be shaped to conform to the lower half of pipe, and recesses four (4) inches in length shall be cut for pipe bells as required, to give uniform bearing making certain that the pipe is properly supported throughout. Provide ample excavation under and around all pipe joints to permit proper caulking, sealing, welding or thread tightening.
- E. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, and fittings. Remove projecting stones and sharp objects along trench subgrade.
- F. All excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be securely held by bracing or sheeting, which bracing and sheeting shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out.

The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., to be used by this Contractor shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.

- G. Grading in the area of the excavation shall be such that it shall prevent surface water from flowing into the excavated trench. Under no circumstances lay, pipe or install appurtenances in water. Keep trench free from water until pipe joint materials have hardened. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the contract price.
- H. Where underground pipes cross, the trench of the lower pipe shall be backfilled with sharp sand, well tamped, to provide bed for higher pipe. Pipes which run parallel and at different levels shall be adequately separated to provide firm bedding for the pipes. Sewer, water and gas pipes shall be run in completely separate trenches, and at least three (3) feet apart at center lines, except as approved by the Engineer. Whenever possible, water pipes shall be installed above sewer pipes and gas piping above water and sewer pipes.

3.13 BEDDING AND BACKFILLING

- A. All excavations by this Contractor shall be promptly backfilled.
- B. Trenches for sewers, piping, etc., shall be backfilled for a depth of at least six (6) inches over the top of pipe with sand. Bedding shall be provided in the form of six (6) inches of sand under the pipes. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed beneath haunches of piping and thoroughly compacted to prevent lateral displacement.
- C. Backfill from 0'-6" above the top of the pipe to the surface shall be with clean on-site materials. Large rocks (over 3/4") or other materials shall be removed. Backfill shall be compacted. Compaction shall be at least 90% measured by the Proctor Test (ASTM D 698). Backfill shall be constructed in uniform layers of approximately 6 to 8 inches in loose dimension. Each layer shall be compacted.
- D. Backfill from 0'-6" above the top of the pipe, sewer, conduit, etc., to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of 1/2".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, recompacted, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, dry by discing or other similar methods. If the soils are too dry during construction of the fill, add water in such a way as to permit uniform dispersion of the moisture through the layer to be compacted.
- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 220010

SECTION 220020 – PLUMBING SEISMIC RESTRAINTS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Provide seismic restraints as indicated for each type of equipment and for piping systems. This section applies to:
 - 1. Plumbing Systems
- B. Scope of Work
 - 1. The following items of equipment shall have flexible pipe connectors installed at the piping connection to the items:
 - a. Water pumps where indicated on the plans.
 - 2. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
 - 3. Seismic control manufacturer shall have the following responsibilities:
 - a. Determine seismic restraint sizes and locations.
 - b. Provide piping and equipment seismic restraints as scheduled or specified.
 - c. Provide installation instructions and drawings.
 - d. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, project seismic requirements. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
 - 4. Friction from gravity loads shall not be considered resistance to seismic forces.
 - 5. All piping shall be restrained per the latest revision of SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Material and Methods.

1.3 REFERENCES

- A. NFPA Standard 13
- B. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 2008.

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: III.
 - a. Component Importance Factor: See Schedule on drawings.
 - b. Component Response Modification Factor: See Schedule on drawings.
 - c. Component Amplification Factor: See Schedule on drawings.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 20.3%.
 - 4. Design Spectral Response Acceleration at 1-Second Period: 16.6%.
 - 5. Seismic Design Category: B.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select seismic restraints.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Seismic Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods,

and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.

- c. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Coordination Drawings: Show coordination of seismic bracing for piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings shall be based on independent testing. If preapproved ratings are not available, submittals shall be based on independent testing. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD or an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.

- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings:
 3. Oil- and water-resistant neoprene.
 4. Maximum 1/4 inch air gap and minimum 1/4-inch thick resilient cushion.
- D. Specification SB: Spring type isolators shall be free standing and laterally stable and complete with 1/4 inch neoprene acoustical friction pads or neoprene cup between the spring and the base plate. All mountings shall have leveling bolts. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections compressed spring height and solid spring height. A steel housing shall be included to resist motion due to earthquake loads. A minimum clearance of 1/4 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. The housing shall be out of contact during normal operations. Mountings used out of doors shall be hot dipped galvanized. Mounting shall be SSLFH or SLR as manufactured by Mason Industries, Inc.
- E. Specification SC: Restraint Cables:
1. ASTM A 603 galvanized for interior locations and ASTM A 492 stainless for outdoor locations -steel cables with end connections made of galvanized/stainless steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Accessories shall be the same material as the cable. Mason Industries, Type SCB Seismic Slack Cables and Type SRC Seismic Rod Clamps.
 2. Strut System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels (struts), 1-5/8 wide, in varying lengths and combinations to meet load capacities, with accessories for attachment to braced component at one end and to building structure at the other end and other matching components; and rated in tension, compression, and torsion forces. 12 gage channels unless otherwise indicated in the approved submittals. Cooper B-Line model B22 strut systems, pipe hangers, and accessories.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Mason Industries Seismic Rod Clamps or B Line SC-228 or SC-UB Hanger Rod Stiffener.
- G. Specification SG: Seismic Grommets. Resilient Isolation Washers and Bushings. One-piece, molded, oil- and water-resistant neoprene, with a flat washer face. The grommets shall be used with a steel washer between the bolt head (or nut if studs are used) and the grommet face. All anchor bolts shall be tightened until there is obvious grommet distortion and the bolt is torqued to 80% of allowable. In no case, shall the anchor bolt torque be less than 50% of the allowable. Mason Industries, Inc. Type HG.
- H. Specification SAB: Seismic Anchor Bolts.

1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. Mason Industries, Inc. Type SAB.
2. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Mason Industries, Inc. Type SAA.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be galvanized.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark seismic control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 220010 for installation of equipment supports, and roof penetrations.
- B. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
3. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
4. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports and longitudinal supports at no more than the maximum of spacing indicated on the drawings or the local building code.
3. Brace a change of direction as indicated on the drawings or the local building code.
4. Install cables so they do not bend across edges of adjacent equipment or building structure.
5. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 per cent. Single sided "C" beam clamps shall not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.

D. Attachment to Structure:

1. Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
2. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the seismic restraint vendor's calculations.
3. Capacity for concrete inserts used for support attachment shall not exceed the combination of gravity and seismic loads on the support.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas pipes.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 220400 Plumbing Piping Systems for piping flexible connections.

3.5 ADJUSTING

- A. Adjust isolators on piping after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 PLUMBING SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. See schedule on plans.

END OF SECTION 220020

SECTION 220400 – PLUMBING SYSTEMS**PART 1 - GENERAL****1.1 SCOPE**

- A. Work under the Plumbing Contract shall include, but is not limited to, all labor, materials, equipment, tools, controls, fees, etc., required to install, test, and start-up the systems described below and/or shown on the contract drawings.
 - 1. New Plumbing Fixtures.
 - 2. New Plumbing Specialties.
 - 3. New Water Heaters.
 - 4. New Plumbing Piping Insulation.
 - 5. New Domestic Hot and Cold Water Piping.
 - 6. New Sanitary Waste Piping and Vent Piping.
 - 7. Insulation for Plumbing piping and equipment requiring insulation.
 - 8. Any miscellaneous items required by applicable plumbing or building codes to meet improvements noted in plans or in these specifications herein.
 - 9. Any miscellaneous or customary items required to provide acceptable performance of the fixtures and systems specified in the plans and in these specifications.
 - 10. Installation or final connections of Owner furnished equipment as indicated on the drawings.
- B. The drawings are generally diagrammatic. Unless specifically shown, the drawings shall not be scaled for positioning of piping, fixtures, or equipment. This Contractor shall coordinate his work with the Architectural drawings and with all other trades in regard to placement of facilities. Contractor shall refer to architectural and structural plans for building construction and dimensions. Refer to architectural "Room Finish Schedules" for material and finish of walls, floors and ceiling so proper roughing-in may be provided.
- C. All plumbing work shall be in accordance with the local plumbing code, the requirements of the Building Code and the Seismic requirements defined in Section 220020 and with seismic details on drawings. If any of these documents are in conflict with the local code authority, the discrepancy shall be noted by the Contractor and sent to the Engineer prior to initiating any work.
- D. All permits and inspection fees required to do this work shall be paid for by Plumbing Contractor. At the completion of the work, the Contractor shall furnish a certificate of approval showing that his work has been approved and accepted by the proper inspection authorities.
- E. Contractor shall be responsible for utility connections.
- F. Excavate for all underground work that requires excavation. See Section 220010 of this specification for excavation and backfill requirements.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Materials and Methods.
- D. Section 220020 - Seismic Restraints.
- E. Section 220410 - Plumbing Equipment.
- F. Section 220420 - Plumbing Fixtures and Trim.
- G. Section 220450 - Interceptors.

1.3 EQUIPMENT FURNISHED BY OTHERS

- A. Where specifically indicated, some items of equipment will be furnished by the Owner or under other Divisions of these specifications.
- B. Unless specifically noted otherwise for the items furnished by others, this Contractor shall receive, locate, set in place, rough-in and make final connections to all items requiring plumbing connections.
- C. Unless specifically noted otherwise, for the items furnished by others, this Contractor shall furnish and install all piping, stops, traps and accessories required to make final connection.

1.4 FIXTURES FURNISHED BY OTHERS

- A. Where specifically indicated on the plans, sinks, disposals, etc., will be furnished and set in place by others. This Contractor shall furnish:
 - 1. P-trap
 - 2. Angle Stop Valves.
- B. This Contractor shall receive and install these items and make final connections.

1.5 SUBMITTALS

- A. This Contractor shall submit shop drawings on all material or equipment furnished by him or his Subcontractors. Manufacturer's technical product data and installation instructions shall be submitted on:
 - 1. All Plumbing Fixtures
 - 2. Floor Drains
 - 3. All Plumbing Equipment
 - 4. Domestic Water Heaters
 - 5. Valves and Piping Specialties
 - 6. List of all proposed piping material and its intended use.
 - 7. Insulation: Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each system requiring insulation.
 - 8. Hangers and Supports: Submit schedule showing Manufacturer's figure number, size, location, and features for each hanger and support.
 - 9. Water system pre and post testing per ASHRAE 188-2018.

1.6 QUALITY

A. Comply with the provisions of the following:

1. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
Compliance: Comply with the various MSS Standard Practices referenced.

B. References

1. ASHRAE 188-2018 Legionellosis: Risk Management for Building Water System
2. ASME B16.18 Cast Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
4. ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint
Drainage Fittings - DWV
5. ASTM A 74 Cast Iron Soil Pipe and Fittings
6. ASTM A 888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and
Storm Drain, Waste, and Vent Piping Applications
7. ASTM B 32 Solder Metal
8. ASTM B 88 Seamless Copper Water Tube
9. ASTM B 306 Copper Drainage Tube (DWV)
10. ASTM B 813-2010 Liquid and Paste Fluxes for Soldering of Copper and Copper
Alloy Tube.)
11. ASTM B 828 Making Capillary Joints by Soldering of Copper and Copper Alloy
Tube and Fittings
12. ASTM C 564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
13. ASTM D 1784 Rigid Poly Vinyl Chloride Compounds and Chlorinated Poly Vinyl
Chloride Compounds
14. ASTM D 1785 Poly Vinyl Chloride Plastic Pipe, Schedules 40, 80, and 120
15. ASTM D 2241 Poly Vinyl Chloride Pressure-Rated Pipe (SDR Series)
16. ASTM D 2321 Standard Practice for Underground PVC Pipe Installation
17. ASTM D2447 Polyethylene (PE) Plastic Pipe, Schedule 40 and 80
18. ASTM D 2464 Threaded Poly Vinyl Chloride Plastic Pipe Fittings, Schedule 80
19. ASTM D 2466 Poly Vinyl Chloride Plastic Pipe Fittings, Schedule 40
20. ASTM D 2467 Socket-Type Poly Vinyl Chloride plastic Pipe Fittings, Schedule
80
21. ASTM D 2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping
Systems
22. ASTM D 2657 Heat-Joining Polyolefin Pipe and Fittings
23. ASTM D 2661 Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain,
Waste, and Vent Pipe and Fittings
24. ASTM D 2665 Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe
and Fittings
25. ASTM D 2774 Underground Installation of Thermoplastic Pressure Piping
26. ASTM D 2855 Making Solvent-Cemented Joints with Poly Vinyl Chloride Pipe
and Fittings
27. ASTM D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
28. ASTM D 4101 Propylene Plastic Injection and Extrusion Materials
29. ASTM E 84 Standard Test Method for Surface Burning Characteristics of
Building Materials.
30. ASTM E 814 Standard Test Method for Fire Test of Penetration Fire Stop

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| | | Systems |
| 31. | ASTM F 477 | Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| 32. | ASTM F 1290 | Electrofusion Joining Polyolefin Pipe and Fittings |
| 33. | AWS A5.8 | Filler Metals for Brazing and Braze Welding |
| 34. | AWWA M23 | Manual: PVC Pipe - Design and Installation |
| 35. | AWWA | Disinfection Building Potable Water Plumbing in New or Repaired Systems November 2024 |
| 36. | CISPI HSN | Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings |
| 37. | CISPI 301 | Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| 38. | CISPI 310 | Mechanical Compression Coupling |
| 39. | NSF/ANSI 61 | Drinking Water System Components |
| 40. | NSF/ANSI 372 | Drinking Water System Components - Lead Content |
| 41. | ASTM C 547 | Standard Specification for Mineral Fiber Pipe Insulation. |
| 42. | ASTM C 1136 | Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation |
| 43. | ASTM C 585 | Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System). |

C. NSF Compliance

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Interior Domestic Water Piping (Copper)

1. Interior Pipe 4" and Smaller:
 - a. Pipe below grade shall be copper, ASTM B88, Type K, soft copper tube annealed temper. No joints shall be allowed below slab.
 - b. Pipe above grade shall be copper, ASTM B88, Type "L" hard copper tube, drawn temper.
2. Fittings and Solder for Copper Tubing:
 - a. All solder fittings shall be wrought copper or cast bronze solder fittings and shall bear manufacturer's trade mark. ASME B16.18 or B16.22 pressure fittings.
 - b. Solder shall be 95-5 complying with ASTM B32; flux shall be ASTM B 813, water flushable type, for 4" and smaller.
 - c. Copper Pressure-Seal-Joint Fittings: Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end. Conforming to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Copper press fittings shall be rated at 200 psi

working pressure and 250 degree working temperature. All copper press fittings, couplings and specialties shall be the products of a single manufacturer. Installation tools shall be as recommended by the fittings manufacturer.

3. Piping exposed to view shall be chrome plated unless otherwise indicated on the plans.

B. Sanitary Waste, and Vent Sewer Piping

1. See application criteria in Part 3 below.
2. Bell and Spigot Cast Iron Soil Pipe and Fittings:
 - a. Service weight pipe and fittings: ASTM A74.
 - b. One piece elastomeric compression type gaskets: ASTM C564.
 - c. Pipe and fittings shall be encased with 8 mil thick polyethylene: AWWA C105.
3. No Hub Cast Iron Soil Pipe and Fittings:
 - a. Service weight pipe and fittings: CISPI 301.
 - b. Mechanical compression coupling with neoprene gasket and stainless steel band and accessories: CISPI 310.
 - c. Heavy Duty Mechanical compression coupling with neoprene gasket and 304 stainless steel band and accessories. Comply with ASTM C-1540; gasket shall conform to ASTM C564. Husky model SD 4000 orange band. No equals allowable.
4. Copper Tubing and Fittings:
 - a. Copper drainage tubing (DWV): ASTM B 306.
 - b. Wrought copper solder type fittings: ASME B16.29.
 - c. Joints: 95/5 type solder. ASTM B 32.
5. Poly-vinyl Chloride Pipe and Fittings:
 - a. PVC schedule 40 solid wall: ASTM D-1785.
 - b. Socket fittings, schedule 40: ASTM D-2665.
 - c. Solvent cement joints: ASTM D-2564.

C. Valves

1. Water Valves:
 - a. All valves of the same type shall be of the same manufacturer.
 - b. All valves shall be lead free complying with NSF-61-G and ANSI 372.
 - c. Valves shall be as indicated using the Nibco figure numbers or the approved equal as manufactured by Crane, Jenkins Bros., Hammond, Milwaukee, Powell, Stockham or Walworth.
 - d. For CW piping systems with 2" or less insulation, provide extended handles on stop valves with a vapor seal, adjustable memory stop and convenient valve packing maintenance - all without disturbing the insulation.
2. Stop valve sized through 2" shall be:

- a. Nibco Fig. No. T-585-66-LF (threaded), full port 400 psi WOG non-shock at 100°F, 2-piece construction, stainless steel ball and trim and bronze body with Teflon O-ring seals and seats.
 - b. Nibco Fig. No. PC-585-66-LF (press system), full port 250 psi WOG non-shock at 100°F, 2-piece construction, stainless steel ball and trim and bronze body with Teflon O-ring seals and seats.
3. Stop valve sized 2-1/2" and larger shall be:
 - a. Non-shock cold water, butterfly valves. Standard: MSS SP-67, Type I. CWP Rating: 2"-6" = 200 psig; 8"-10" = 150 psig. Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange. ASTM A 126, cast iron or ASTM A 536, ductile iron. Seat: EDPM. One- or two-piece stainless steel stem. Aluminum bronze disc.
4. Check valves through 3" shall be threaded swing check valves.
5. Check valves over 3" shall be wafer style check valves.
6. Balance Valves
 - a. Self-actuating thermostatic
 - 1) Valve shall automatically and continuously adjust flow to maintain a specified temperature at the end of each piping branch or riser.
 - 2) Compliant with the Buy America Act
 - 3) Lead free & NSF 61 Certified
 - 4) 3 year warranty
 - 5) Tamper Proof - Fixed set-point
 - 6) Stainless steel - corrosion resistant
 - 7) ½" through 2"
 - 8) High Cv

2.2 Y-PATTERN STRAINERS

- A. Manufacturer: Subject to compliance with requirements, provide domestic water piping system products from one of the following:
 1. Armstrong Machine Works
 2. Keckley
 3. Illinois
 4. Mueller Steam Specialty
 5. Metraflex Co.
 6. Spirax Sarco.
- B. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- C. Body: Bronze for NPS 3 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 4 and larger.
- D. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

E. Screen: Stainless steel with round perforations, unless otherwise indicated.

F. Perforation Size:

1. Strainers thru NPS 2-1/2 inch: #20 mesh.

G. Drain: Pipe plug.

2.3 UNIONS

A. All unions shall be streamline ground joints. Dielectric unions may be solder joint, screwed or flanged.

2.4 VACUUM BREAKERS

A. This Contractor shall furnish and install vacuum breakers in the following locations where a vacuum breaker is not an integral part of the fixture:

1. All water closet flush valves.
2. All urinal flush valves.
3. All wall hydrants and all hose bibbs.
4. Janitor's sinks and mop basins.
5. Shelf mounted water heaters.

B. In addition to the above locations, vacuum breakers shall be installed where required by governing local authorities, on all connections to domestic water system to which hoses could be attached and all connections to the domestic water system where back siphonage could occur.

2.5 PIPE INSULATION

A. The piping insulation material is specified to establish the desired quality and performance. Equal products, complying with the requirements of these specifications, by the following manufacturers are acceptable:

1. Owens-Corning
2. Johns Manville
3. Knauf Insulation
4. Armacell
5. Rubatex
6. Manson Insulation

B. Insulation material:

1. Type (1) – Fiberglass Preformed Pipe Insulation: Glass fibers bonded with thermosetting resin, complying with ASTM C547, Type I. Fiberglass with factory-applied, ASJ SSL+ all service polymer jacket with self-sealing lap down joints and butt strips, complying with ASTM C1136. Vapor barrier in jacket. Thermal conductivity shall be 0.23 BTU/HR/SF°F/IN @ 75°F mean temperature, 0.26 BTU/HR/SF°F/IN @ 100°F mean temperature, 0.3 @ 200°F, 0.35 @ 300°F or less.

2. Type (2) – Flexible Elastomeric Insulation: (Plenum rated) foamed plastic flexible tubing insulation. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 100°F mean temperature.
- C. The installed insulating system shall comply with the requirements of the National Fire Protection Association. Insulation, including finishes and adhesives, on the exterior surfaces of pipes and equipment shall have a flame spread of 25 or less and a smoke developed rating of 50 or less as determined by an independent laboratory in accordance with ASTM E84/UL 723.
- D. Piping insulation material shall be plenum rated with UL listing.
- E. All insulation shall be rat, vermin, germ, fungus and rot resistant.
- F. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.
- G. See Part 3 - Execution for items to be insulated.

2.6 HANGERS

A. Manufactured Units

1. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69 except as modified herein.
 - a. Hangers: Types 5 and 12 shall not be used.
 - b. Hangers: Type 3 shall not be used on insulated piping.
 - c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 - d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
 - e. Hangers: Type 24 shall be used only on trapeze hanger systems or on fabricated frames.
2. Pipe supports shall be equal to B-Line model numbers hereinafter listed. Equal products by Grinnell also acceptable.

a. Clevis Hanger	Fig. B 3100
b. Adjustable Swivel Ring	Fig. B 3170
c. Adjustable Swivel Roller	Fig. B 3111
d. Adjustable Roller Support	Fig. B 3121 or Fig. B 3122
e. Riser Clamp (Standard Duty)	Fig. B 3373
f. Riser Clamp (Heavy Duty)	Fig. B 3131
g. Offset Clamp	Fig. B 3148
h. Wall Bracket (Light Duty)	Fig. B 3068
i. Wall Bracket (Medium Duty)	Fig. B 3065
j. U-Bolts	Fig. B 3188
k. Structural Attachments:	
Beams clamps:	Fig. B 3031, B 3033, B 3034, B 3050, B 3045
Angle Iron Beam Clamp:	Fig. B 3046

Bar Joist:	Fig. B 3059
Concrete Inserts:	Fig. B 3500, B 2505 thru 2508, or B 3014
Drilled Inserts:	Phillips Red-head, wedge anchors or equal.

- B. Components shall have galvanized or cadmium plated coatings where installed for piping and equipment that will not have field-applied finish.
- C. Pipe supports shall be compatible with the pipe being supported to prevent galvanic corrosion. All supports for copper piping shall be copper coated hangers conforming in general to the above specifications. Where copper pipes are separated from hangers by pipe insulation, hangers do not need to be copper coated.
- D. Saddles and hangers for insulated piping:
 - 1. Type 40 shields shall:
 - a. Be used on all insulated pipes less than 12 inches.
 - b. Have rigid insulation saddle, or insulation pipe hanger consisting of rigid urethane foam insulation with vapor barrier jacket and thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation saddle length shall be 6" for pipes 6" and smaller. Thickness shall be the same as pipe insulation.
 - c. Distribute the loading on the bearing area of the insulation in accordance with the following minimum dimensions covering 180° of arc:

Pipe Size (Inches)	Galvanized Steel Saddle Length (Inches)	Gauge Thickness
½ to 4	12	16
6	18	16
8	24	14
10 and larger	24	14

2.7 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - c. or equivalent
 - 2. Description: Manufactured assembly made of 5.0-lb/sq. ft., 0.0782-inch thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

PART 3 - EXECUTION

3.1 PIPING APPLICATION

- A. Domestic Water Piping Above Ground

1. Piping 4" and smaller
 - a. Above Ground Domestic Water Piping shall be copper.
 - b. Above Ground Copper Domestic Water Piping above grade shall be soldered, roll groove fittings or Pressure-Seal-Joint fittings as indicated below:
 - 1) Thru 2": Soldered or Pressure-Seal-Joint fittings.
 - a) Pressure-Seal-Joint fittings not allowable in concealed locations.
(Above drywall ceilings, in chases and in walls.)
 - 2) 2" thru 4": Soldered fittings.

B. Domestic Water Piping Under Building Slab or Below Ground, with-in 5' of building wall.

1. Piping 4" and smaller
 - a. PVC pipe and fittings
 - b. PE pipe and fittings
 - c. Copper pipe and fittings

C. Sanitary Sewer

1. Below Building Slab on Grade Install:
 - a. cast iron hub and spigot (Kitchens or other areas where high temperature waste water is being discharged)
 - b. PVC
2. Above Grade Install:
 - a. hubless cast iron
 - b. PVC (except not allowed in return air plenums)
 - c. Copper sanitary piping.
3. Beyond 5 Feet Outside Building Line:
 - a. See Civil Plans.

3.2 PLUMBING SYSTEMS INSTALLATION

A. Interior Water Piping System

1. The Plumbing Contractor shall furnish all materials and labor to install the cold water, hot water and hot water circulating piping systems. Unless specifically stated otherwise, piping shall be extended and connected to all fixtures or equipment requiring domestic hot and cold water.
2. All piping shall be installed level and plumb. All pipes shall be properly cleaned inside and outside.
3. Provide strainers where indicated on the plans and details.

B. Installation of Piping

1. All pipe shall be run parallel to or at right angles to walls, beams, or columns. Pipe shall be run as direct as possible, but no short cut diagonal methods will be allowed, avoiding unnecessary offsets and maintaining maximum headroom.
2. Piping shall be concealed in finished rooms unless noted otherwise.
3. Piping drawings are to be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be furnished and installed by this Contractor. Pipe and fittings must be installed so that all pipe and/or insulation completely clears all nearby structures, piping and items by other contractors.
4. Piping shall be arranged to allow for expansion and contraction. Expansion loops, expansion joints, and pipe anchors and guides shall be provided on piping mains where shown on the drawings or where required to avoid additional stresses in the piping and supports.
5. Pipes shall not be hung from other piping or from equipment of other trades. No hanger rods or piping shall pierce ductwork.
6. Bull head tee arrangements shall not be allowed.
7. The entire water system shall be free of water hammer. Air chambers shall not be used in place of water hammer arresters. Install water hammer arresters where indicated on the plans and as required for all quick closing valve devices per manufacture requirements. Plumbing fixtures that require water hammer arresters shall include but not be limited to the following:
 - a. Washing machines.
 - b. Dishwashers.
 - c. Mop Service Basins.
 - d. Wall Hydrants.
 - e. Lavatories.
 - f. Water closets.
 - g. Urinals.
 - h. Showers.
 - i. Kitchen sinks.
 - j. Drinking Fountains and electric water coolers.
 - k. Ice makers.
 - l. Kitchen equipment such as coffee machines, etc.
8. Valves shall be installed on each branch and at each piece of equipment, fixture or fixtures group, and all other items requiring water supply shall be separately valved to allow equipment or fixture removal without shutdown of the entire system. All valves shall be located as to be easily accessible. Install valves in horizontal piping with stem at or above the center of the pipe.
9. Use ball and butterfly valves for shut-off duty; ball, and butterfly for throttling duty. Refer to drawings for specific valve applications and arrangements. Use ball valves for isolation on pipe sizes 2" and smaller. Use butterfly valves for isolation on pipe sizes 2½" and larger.
10. Unions shall be installed:
 - a. At piping connections to equipment.
 - b. Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flanges.

11. All valves and specialties must be placed to permit easy operation and shall be made accessible to use, or provided with access panels. Special care must be taken to provide room for removing the inner parts of all specialties. Access panels must be sized properly for maintenance purposes and repairs.
12. If dope, lead or cement is used in making up joints, it shall be based on male threads only.
13. Routing of piping shall be coordinated with other trades to assure adequate space for electrical and mechanical installations above ceilings and in chases. Piping shall not be routed through electrical rooms/closets or elevator equipment rooms.

C. Installation of Hangers and Supports

1. All piping shall be supported from the building structure by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitching of pipes, to prevent vibration and excessive deflections, and secure piping in place.
2. Contractor shall verify loading on hangers, hanger rods and structural attachments. Loading on the assembly shall not exceed 75% of the manufacturer's rating for any component of the assembly. If loading does exceed the 75%, then hanger spacing shall be reduced.
3. Hangers and supports shall be provided as required to eliminate vibration and excessive deflection, but in no case over the following centers, unless specifically indicated otherwise on the drawing. Rod sizes for individual pipe shall not be less than the following schedule: (DI= ductile iron, CI= cast iron, STL= steel, CU= copper)

Pipe Size (Inches)	Maximum Hanger Spacing (Feet) DI/CI/STL	Minimum Rod Size (Inches) DI/CI/STL	Maximum Hanger Spacing (Feet) CU	Minimum Rod Size (Inches) CU/PVC
1/2	7	3/8	5	3/8
3/4	7	3/8	5	3/8
1	7	3/8	6	3/8
1-1/4	7	3/8	7	3/8
1-1/2	9	3/8	8	3/8
2	10	3/8	8	3/8
2-1/2	11	1/2	9	1/2
3	12	1/2	10	1/2
3-1/2	13	1/2	11	1/2
4	14	5/8	12	1/2
5	16	5/8	13	1/2
6	17	3/4	14	5/8

- a. An additional hanger shall be installed at every change in direction of piping.
- b. Cast-iron and ductile iron pipe shall have minimum one hanger per section close to each joint and at branch connections.

- c. Plastic pipe shall have hangers spaced in accordance with manufacturer's recommendations.
- 4. When trapeze hangers are used to support two or more pipes, rods shall be used for vertical hanger members and angles, channels or Unistrut for horizontal hanger members. The material used shall be sized to support the load without excessive deflection. Spacing of trapeze hangers shall be based on the smallest pipe supported on the trapeze hanger. Rod sizes shall be based on the supported weight and load carrying capacity of attachment device.
- 5. Horizontal pipe supports shall be:
 - a. Spaced as specified in MSS SP-58.
 - b. Installed $\leq 1'$ from the pipe fitting joint, at each change in pipe direction.
 - c. $\leq 5'$ apart at valves.
 - d. Pipe hanger loads ≥ 50 lbs, suspended from steel joists, shall have the hanger loads suspended from panel points.
 - e. Maximum of $4'$ on center for PVC piping. *Note: Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements.*
 - f. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.
- 6. Vertical pipe shall be supported at each floor with riser clamps, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.
- 7. Piping shall not be supported from joist bridging or a roof metal deck.
- 8. Pipe supports shall be structurally capable of carrying the pipe or pipes supported by them and shall be capable of vertical adjustment after installation of piping.
- 9. Piping at all equipment shall be supported to prevent strains or distortions in the connected equipment. Piping shall be installed and supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed. Unions shall be installed at the connection to all equipment and at valves, strainers, traps, etc.
- 10. Domestic water pipes which are subject to rapid changes in flow rate shall be anchored to prevent excessive movement or vibration.

D. Interior Waste, Soil, and Vent Piping

- 1. The arrangement of the system shall be as shown on the drawings, and as direct as possible avoiding all unnecessary offsets.
- 2. Supporting of horizontal and vertical pipe shall be as hereinbefore described under "Installation of Piping".
- 3. Horizontal soil and waste pipes $4"$ and larger shall be given a minimum slope of $1/8"$ per foot, and pipes $3"$ and smaller shall be given a pitch of $1/4"$ per foot. All main vertical soil and waste stacks shall be installed with provision for expansion and shall be extended full size to and above the roof line as vents, except where otherwise specifically indicated.
- 4. Horizontal oil or grease waste piping shall be given a minimum slope of $1/4"$ per foot.
- 5. Where practical, two or more vent pipes shall be connected together and extended as one pipe through the roof. Where the Contractor makes changes of vent connections

other than that indicated, he shall keep a record of the change. Vent pipes shall be run with horizontal piping pitched down to stacks without forming traps in pipes using fittings as required. Where an end of circuit vent pipe from any fixtures or line of fixtures are connected to a vent pipe serving other fixtures, the connection shall be at least 6" above the flood rim of the highest fixture above the floor on which the fixture is located.

6. All pipe shall be carefully handled and protected from damage. Damaged pipe shall not be installed.
7. All open drains shall be covered and protected during construction from all construction debris for the entire construction schedule. Open drains listed but not limited to; floor drains, floor sinks, trench drains, showers, bathtubs, lavatories, sinks, toilets, mop basins drinking fountains.
8. Bedding for underground pipes shall be as specified in Section 220010.
9. All changes in pipe size on soil, waste and drain pipes shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of combo wye and 1/8 bend, wye, long sweep 1/4 bends, 1/6, 1/8 or 1/16 bends, except that sanitary tees may be used on vertical stacks, and short 1/4 bends or elbows may be used in soil and waste pipes where the change in direction of flow is from the horizontal to the vertical and on the discharge from water closets.
10. Slip joints will be permitted only in trap seals or on the inlet side of the traps. Tucker or hub drainage fittings shall be used for making union connections wherever practicable in connection with dry vents.
11. Vent pipes shall be flashed. This Contractor shall furnish and install all flashing and counter-flashing. Flashing shall be 5 pound lead. Flashings in connection with cast-iron pipe vents will be extended up to top of vent and turned down into pipes or hubs minimum 1". For pipes through outside walls, turn flanges back into wall, flash, metal counterflash and seal.
12. Seal drains watertight to adjacent materials.
13. Each fixture and piece of equipment requiring connection to the drainage system, except fixtures with continuous waste, shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double-trapped. Traps installed on hub and spigot pipe shall be cast-iron. Traps installed on threaded pipe shall be recessed drainage pattern.
14. The vent stack shall be connected to the soil stack below the lowest fixture and carried up, all individual vents being connected thereto, extending through the roof.
15. Vents extending through the roof shall be a minimum of 25' from any supply fan or fresh air intake. If necessary, the vent shall be offset to meet this requirement. Check location of air intakes on equipment on roof prior to installation of vents.
16. Double wye soil, waste and storm pipe fittings are not allowed to be installed horizontally.
17. Wrap all pipe routed through concrete with polyethylene pipe guard before pour to de-couple pipe from concrete.

E. Service Entrance

1. Extend water distribution piping to connect to utility water service piping, of size and in location indicated for service entrance to building.

2. Install sleeve and mechanical sleeve seal at penetrations through foundation wall and valve pits for watertight installation.
3. Install backflow preventer at service entrance inside building; complete with strainer, pressure gauge, test tee with valve and drain valve.
4. Minimum depth of water pipe, exterior to building, shall be below the locally established frost line, but not less than 3'-6".

F. Installation of Underground Water Piping

1. Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other pipes or as authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.
2. Special care shall be taken to insure that the pipes are solidly and uniformly bedded and cradled. Bedding for underground pipes shall be as specified in Section 220010.
3. Water pipe connections to mains shall be left uncovered until after an acceptance inspection has been made. After approval of the connection, the trench shall be backfilled.
4. All underground water pipes shall be clamped, anchored, flushed and tested in accordance with NFPA Pamphlets 13 and 24. Provide thrust blocks.
5. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23. Ductile-Iron Pipe shall be installed in accordance with AWWA C600.
6. Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Engineer.
7. Flanged pipe shall only be installed above ground or with the flanges in valve pits.
8. Polyethylene wrap shall be installed around all below grade ferrous piping, fittings and joints in conformance with AWWA Standard C105. Joints and fittings shall be cleaned, coated, and wrapped with tape after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

G. Sewer Pipe and Water Main Separation

1. Sanitary sewers parallel to water mains shall be located at least 10 feet horizontally from water mains. Distance shall be measured from edge to edge.
2. When local conditions prevent a horizontal separation of 10 feet, a sanitary sewer may be laid closer to a water main provided:

- a. That the bottom of the water main is at least 18 inches above the top of the sewer.
- b. That the joints be centered at the point of crossing and as far as possible from the water main.

H. Cleanouts and Test Tees

1. Cleanouts shall be provided at the following locations:
 - a. Bottom of each exposed fixture trap not integral with the fixture.
 - b. At the foot of each soil and storm water stack.
 - c. At intervals not exceeding 50' for 4" sewer pipes and smaller, and not exceeding 100' for 5" sewer pipe and larger.
 - d. Miscellaneous locations as shown on the plans.
 - e. Where required by code.
2. Cleanouts shall be the same size as the pipe except cleanout plugs larger than 4" will not be required. Cleanouts installed in connection with cast-iron hub and spigot pipe shall consist of a long sweep 1/4 bend or one or two 1/8 bends extended to an easily accessible place, or where indicated on the drawings. An extra heavy cast-iron ferrule with screw cap plug shall be caulked into the hub of the fitting. Where cleanouts in connection with threaded pipe are indicated and are accessible, they shall be cast-iron drainage T-pattern 90° branch fittings or Y-branch fittings with screw plugs of the same size as the pipe up to and including 4". Test tees with cleanout plugs shall be installed at the foot of all soil, waste, and drain and roof drainage stacks and on each building drain outside the building.
3. Wall Access Cover Plate: Round, flat, chrome-plated brass or stainless-steel cover plate with screw. Deep, chrome-plated bronze type may be used where a flat type does not fit.

I. Joints

1. Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees shall not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.
2. Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.
3. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
4. Soldered joints shall be made with flux and are only acceptable for pipes 2 inches and smaller. Soldered joints shall conform to ASME B31.5.
5. Copper Tube Extracted Tee Joints shall not be allowed.

6. Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.
7. Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.
8. The tube or fittings for copper piping shall not be annealed when making connections.
9. PVC pipe shall have joints made with solvent cement, elastomeric gaskets, or mated flanges.
10. Joints connecting pipe of differing materials shall be made with transition fittings approved by the pipe manufacturer and in accordance with the manufacturer's recommendation as approved by the Engineer.

J. Backup Plates

1. Where hot, cold and waste piping penetrates chase walls for connections to fixtures, this Contractor shall furnish and install backup plates. Backup plates shall span between and shall be firmly attached to the studs on either side of the fixture. Backup plate shall not be less than 3/4" plywood and shall be attached to the metal stud flange with at least three screws on each end. Holes through the backup plates for pipe penetrations shall be accurately drilled to pipe size to provide a close fit with the pipe. Piping shall be secured to the backup plate.

K. Escutcheons

1. Chrome plated escutcheons shall be provided at all locations where pipes penetrate walls in exposed locations.

L. Piping Insulation

1. Installation of the material shall comply with the manufacturer's recommendations.
2. Piping insulation and jacketing shall be applied in accordance with latest addition of MICA (Midwest Insulation Contractors Association). Insulation and Jacketing shall be applied with MICA Plate requirements. Insulation at hangers shall be applied in accordance with MICA Plate requirements. Insulation for fittings, valves, flanges, and couplings shall be installed in accordance with MICA Plates.
3. Unions, flanges, valves and other similar fittings shall be insulated except insulation may be omitted on unions for hot water piping.
4. Prior to application of insulation, piping and equipment shall have been tested. All surfaces to be insulated shall be clean and dry. Special solvents are not required for use in cleaning, but any oil, grease, dirt or foreign material shall be wiped or scraped from the pipe or equipment surface. Insulation shall not be applied on damp or frosty surfaces.
5. All pipes with hangers, saddles, etc., shall be set in their permanent location before insulation is applied. Should it be necessary to block or shore up pipe to install insulation, or should it be necessary to displace or remove hangers, the pipe and hangers shall be restored to their original location and alignment when the insulation is complete.
6. All fittings, flanges, valves, instruments, hanger rods and clamps shall be insulated with molded or mitered insulation or built-up insulation to a thickness equal to that of the

insulation of the adjoining pipe, securely adhered and wired in place. For cold services (fluid temperatures less than 75°F) paint insulation with a vapor-barrier mastic. Fittings shall be covered with preformed fitting covers. Aluminum fitting covers are equally acceptable. For cold services, wrap the end joint with pressure sensitive joint tape furnished by the insulation manufacturer.

7. At pipe hangers, pipe hanger insulation inserts the same thickness as the insulation to prevent crushing the insulation.
8. Insulate Piping as follows:

a.	Application	Insulation Type	Wall Thickness
	CW & NP under 1-1/2"	1	½"
		2	½"
	CW & NP 1 ½" and over	1	1"
	HW, TW & HWR under 1 1/2"	1	1"
		2	1"
	HW, TW & HWR 1 1/2" and over	1	1 1/2"

3.3 PLUMBING SYSTEMS TESTING

- A. It shall be the responsibility of this Contractor to test, and to place all equipment, piping, materials, etc., installed by him into proper and unattended operation.
- B. Piping systems shall be tested as hereinafter described. Piping or equipment not installed by this Contractor shall not be subject to tests. Existing piping or piping which is the property of utility companies shall not be subject to tests.
- C. All plumbing tests shall be made in the presence of the local Plumbing Inspector and Owner's representative unless approved otherwise by the engineer. Testing procedure shall conform to the regulations and codes of the local agency. All pipework shall be tested for leaks, cracked pipes, cracked fittings. All openings shall be capped or plugged, the pipework filled with water, and the installation proven tight before insulation and furrings are applied.
- D. Piping systems shall be tested in ambient temperatures of 40°F or higher.
- E. Testing of Soil, Waste and Vent Piping
 1. All underground soil, waste and vent piping shall be tested with water. The water shall maintain a constant level at the highest point or at least 10' above the mean elevation of the piping under test for at least one (1) hour. If leaks appear, lines shall be drained, leaks repaired and test repeated. No piping shall be concealed in any manner before being tested and approved.
 2. If local code is more stringent than the above test, then all soil, waste and vent piping shall be tested in accordance with local code.
- F. Water System Testing

1. All water piping shall be tested with water at 100 psi or 1-1/2 times the maximum working pressure, whichever is greater. Pressure shall be maintained for a period of one hour. If leaks appear, pipes shall be drained, leaks repaired, and test repeated. No piping shall be concealed in any manner before tests are approved.
2. All domestic systems shall be disinfected in accordance with procedures described in AWWA Standard for Disinfecting for Building Potable Water Plumbing in New or Repaired Systems, AWWA November 2024, and in accordance with applicable local codes. The system shall be flushed prior to chlorination as thoroughly as possible. Clean all faucets strainers and shower heads. A velocity in the system of at least 2.5 fps should be developed. Chlorine shall be added to the system at the meter at a rate sufficient to produce a chlorine concentration of 50 mg/l available chlorine and held in the system for a 24-hour retention period. After chlorination, the system shall be flushed until the chlorine residual is 1.0 ppm at all faucets and shower heads. Testing for domestic systems shall be in accordance with ASHRAE 188-2018.

END OF SECTION 220400

SECTION 220410 – PLUMBING EQUIPMENT**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Furnish all labor, services, material and related items to completely furnish and install the plumbing equipment indicated on the plans and/or specified herein.

1.2 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 220000.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include heat exchanger dimensions, size of tappings, and performance data.
- D. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- E. Indicate pump type, capacity, power requirements and affected adjacent construction.
- F. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
- G. Data for inclusion in Operating and Maintenance Manual specified in Section 220000.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Materials and Methods.
- D. Section 220020 - Seismic Restraints.
- E. Section 220400 - Plumbing Systems.

1.4 QUALITY ASSURANCE

- A. Hydraulic Institute Compliance: Design, manufacture, and install pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Provide components complying with NFPA 70 "National Electrical Code."
- C. UL Compliance: Provide pumps which are listed and labeled by UL, and comply with UL Standard 778 "Motor Operated Water Pumps."
- D. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements, and are based on the specific manufacturer types and models indicated. Equipment having equal performance characteristics by other manufacturers may be

considered, provided deviations in dimensions and profiles and efficiencies do not change the design concept or intended performance as judged by the Engineer.

- E. Motor Selection: Select pump motors which cannot overload over the full operating range of the pump.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to job site.
- B. Store products in a dry location.
- C. Retain shipping flange protective covers and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with manufacturer's rigging instructions for handling.

1.6 NSF COMPLIANCE

- A. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

PART 2 - PRODUCTS

2.1 HOT WATER CIRCULATING PUMPS

- A. Centrifugal pump selections have been based on the manufacturer scheduled. Equivalent products complying with these specifications by the following manufacturers are acceptable:
 - 1. Bell & Gossett
 - 2. Peerless
 - 3. Taco
 - 4. Paco
 - 5. Federal
 - 6. Weinman
- B. Pumps shall comply with the following:
 - 1. In-line type with all bronze construction.
 - 2. Suitable for continuous duty while pumping water up to 200°F.
 - 3. Type: Vertical, single stage, close coupled, radially split casing, for 175 psig working pressure. Suitable for vertical or horizontal installation.
 - 4. Casing: Cast iron, with suction and discharge gage ports, casing wear ring, seal flush connection, drain plug, flanged suction and discharge. Adjustable foot to support floor mounted pumps.
 - 5. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
 - 6. Shaft: Alloy steel with bronze or stainless steel shaft sleeve in wetted area.
 - 7. Seal: Carbon rotating against a stationary ceramic seat, carbon-ceramic type, Buna N bellows, brass and stainless steel metal parts, suitable for operating temperatures up to 225 degrees F.
 - 8. Provide either an internal or external flush line for the mechanical seal.
 - 9. Pump performance curves shall be included with the submittals. Pump selection shall be such that the impeller diameter does not exceed 85% of the cut water radius.
 - 10. Pump speed shall not exceed 3550 rpm.

11. Pump capacity shall be as scheduled.

2.2 INSTANTANEOUS TYPE ELECTRIC WATER HEATER

- A. The instantaneous heater shall be Stiebel Eltron, Eemax, Chronomite.
- B. Flow rate shall be factory set to give a satisfactory range of operating temperature to 110°F maximum. Voltage shall be 208V, 1 phase.
- C. If local code requires a pressure and temperature relief valve, it shall be installed on the hot water outlet pipe before the isolating valve.

2.3 GAS WATER HEATER

- A. Heater shall be A.O. Smith, State, Rheem-Ruud, Lochinvar, or approved equal.
- B. Glass-lined, non-condensing, commercial gas fired water heater. Input rating and recovery capacity as shown on drawings. Multi-flue tank shall be constructed in accordance with ASME Code Section IV and stamped for 160 psi working pressure. Tubes shall be covered with pure dead soft copper and expanded and beaded into the tube sheets to permit field replacement.
- C. The water heater shall be insulated with heavy density fiberglass insulation and trimmed with heavy gauge enameled steel jacket. Lower operating thermostat, upper operating thermostat, temperature limiting device and a drain valve shall be factory installed. An ASME pressure and temperature relief valve shall be furnished and installed.
- D. The complete water heater shall be listed by the American Gas Association Laboratories for operation at outlet water temperature of 180 degrees F.
- E. The water heater shall include all standard equipment as shown on manufacturer's specification sheet, shall fit properly into the space provided for it and shall conform to the drawing requirements.

2.4 EXPANSION TANK (DOMESTIC WATER)

- A. Expansion tanks shall be Armstrong, Watts or approved equal.
- B. Pre-pressurized steel tank with a Butyl diaphragm expansion membrane that prevents contact of water with the air. 150 psig maximum working pressure. 40 psig air precharge. Thermally fused epoxy liner. Field adjustable pre-charge. Inline mounting model.
- C. See schedule on plans for size.

2.5 PRESSURE REDUCING VALVE

- A. Provide Watts or approved equal by Cla-Val, Cash, or Wilkins (Zurn).
- B. Water pressure regulator, ASSE type 1003, rated for initial working pressure of 150 psig minimum, size, and inlet and outlet pressures indicated. Include Y type strainer ahead of regulator.
- C. 2-½ inches and smaller: Bronze body with threaded ends.

- D. 3 inches and larger: Bronze or cast iron body with flanged ends. Line cast iron bodies with FDA approved epoxy coating.
- E. Single seated, direct operated type.

2.6 BACKFLOW PREVENTERS**A. Reduced Pressure Backflow Preventer**

- 1. Watts or approved equal by Ames, Cla-Valve or Febco.
- 2. Reduced pressure principle backflow preventer shall be ASSE type 1013 consisting of gate or ball valves on the inlet and outlet, an inlet strainer and a pressure differential relief valve having an ASME A 112.1.2 air gap fitting located between two positive seating check valves; suitable for 125 psi normal working pressure at temperatures up to 140°F. Size indicated on drawings.
- 3. Valve bodies shall be either bronze or galvanized cast iron. Valve internals shall be constructed of bronze and stainless steel.

2.7 WATER METERS**A. Manufacturer: Subject to compliance with requirements, provide meter(s) of one of the following:**

- 1. Badger Meter, Inc.
- 2. Hays Div., Romac Industries
- 3. Hersey Products, Inc.
- 4. Neptune Water Meter Co.; Subs. Neptune International Corp.
- 5. Rockwell International; Measurement & Flow Control Div.

B. Magnetic Driver Turbine Meter

- 1. Magnetic driver turbine meter type suitable for fluid with hermetically sealed register.
- 2. Provide water meter with bronze outer case and bronze bottom cap. The register lid shall be made of high impact resistant plastic.
- 3. The register shall be completely separated from the product to be measured and shall be available with center sweep hand, straight reading totaling in cubic feet.
- 4. Water meter shall be Hersey Model MVR or equal.

C. Compound Water Meter

- 1. Provide Neptune Model "Tru/Flo Compound" with dual suspension rotating disc and turbine meter type.
- 2. Provide water meter with bronze outer case and bronze bottom cap. The register lid shall be made of high impact resistance plastic.
- 3. Water meter shall be provided with A.R.B. cubic feet automatic reading and billing system.

2.8 EXPANSION LOOPS**A. Expansion Loops shall comply with the following:**

1. For copper pipe applications, pipe fittings shall be type L copper wrought copper or bronze metal with a bronze hose and braid with fittings for solder connections, 150 psi working pressure at up to 250°F.
2. For storm drain applications, pipe fittings shall be schedule 40 steel with a series 300 stainless steel hose and braid with 150# flanged connections, 150 psi working pressure at up to 150°F.

2.9 THERMOMETERS

- A. Thermometers shall be equal to Weiss #A9VU35. Equivalent products complying with these specifications by the following manufacturers are acceptable:
1. Marsh
 2. Miljoco
 3. Trerice
 4. Weiss
 5. U.S. Gauge
 6. Weksler
- B. Red Reading Mercury Industrial Thermometers cast of extruded brass or aluminum closed cases, stainless steel or brass tapered bulbs with bulbs in direct contact with metal, individually calibrated tubes and engraved scales. Each 9" thermometer shall have adjustable angle and shall be installed in a matching brass separable socket with a 3/4" NPT. Stem length of socket shall be 3-1/2" except on lines where the insulation thickness exceeds 3" the stem length shall be 6" with an extension neck socket.
- C. Thermal wells in liquid lines shall be brass construction of same manufacturer as thermometers with 3/4" NPT, cap and chain, and shall have Government Standard tapered walls. Socket length shall be 3-1/2" under hex, except on lines where the insulation thickness exceeds 3" the length shall be 6" including 2-1/2" extension neck.
- D. All thermometers and thermal wells shall be by one manufacturer and shall be interchangeable.
- E. Graduation of thermometers shall be as follows:

	RANGE(°F)	DIVISIONS	FIG. INTERVAL
Hot Water	30 to 240	2°F	20°

- F. Submit shop drawings on thermometers and thermal wells.

2.10 PRESSURE GAUGES

- A. Gauges shall be Trerice. Equivalent products complying with these specifications by the following manufacturers are acceptable:
1. Marsh
 2. Miljoco
 3. Weiss
 4. U.S. Gauge

5. Weksler.

B. Gauges shall include the following:

1. 4-1/2" diameter
2. Closed type ring with clear glass
3. Bronze tube, Bourdon Type
4. Brass movement
5. 1/4" NPT bottom connections with brass tee handle cock
6. Use pressure "snubbers" at locations where gauge needle pulsation might occur

C. Graduation of pressure gauges shall be:

	RANGE	DIVISIONS	FIG. INTERVAL
City Water	0-150 psi	1.0 psi	10 psi
Domestic Hot Water	0-100 psi	1.0 psi	10 psi

D. Gauge cocks shall be brass, equal to Trerice No. 865 or 880, and shall be provided at all gauges.

2.11 PRESSURE BOOSTER PUMP SYSTEM

A. Booster pump selections have been based on the manufacturer scheduled. Equivalent products complying with these specifications by the following manufacturers are acceptable:

1. Bell & Gossett
2. Grundfos
3. Syncro Flo

B. Provide a factory pre-piped and pre-wired assembly constant speed pumping system with pressure regulating valves. Components shall be mounted on a steel frame complete with pumps, motors and automatic controls. Assembly shall employ one lead pump for low flows and a lag pump for higher flows. The system capacity and capacity of individual pumps shall be as scheduled on the drawings.

C. System shall be provided with a single point power connection and suction & discharge piping connections. Isolation valves shall be provided for each pump and PRV set.

D. System shall be rated for 175 psig working pressure.

E. Cast iron body pressure regulating valves with non-slam check valves and bronze discs shall be provided for each pump. Each PRV shall be sized for a maximum pressure drop of 5 PSIG at the scheduled flow rate for its respective pump.

F. A flow sensor shall be provided to stage the pumps with two steps of control (50%-100%).

G. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the suction and discharge headers which shall be copper or stainless steel, flanged, and properly supported.

H. The control panel shall be UL listed with a NEMA 1 enclosure and shall include the following:

1. Fusible disconnect switches for each pump motor

2. Magnetic motor controllers for each pump motor
 3. "HAND-OFF-AUTOMATIC" switches for each pump
 4. External resets
 5. Automatic alternation of equally sized pumps
 6. Time delays
 7. Control power transformer
 8. Minimum run timers
 9. Indicating lights for power on, individual motor overload, and low suction pressure.
 10. The control circuit shall be interlocked so that failure of any controller shall energize the succeeding controller.
 11. Wiring terminal strip.
- I. The pump controller shall provide the following features:
1. Low Suction Pressure Alarm and Cut Out
 2. High Suction Pressure Alarm and Cut Out
 3. Low System Pressure Alarm
 4. High System Pressure Alarm and Cut Out
 5. High Temperature Alarm and Cut Out
 6. Low Level Alarm and Cut Out
 7. No-Flow Shut Down
 8. Audio-Visual alarm with push to silence feature
 9. Overload Failure Alarm
 10. Pump Failure Alarm
 11. Dry contacts for system alarm output and pump status indication shall be provided for connection to a future Energy Management System.
- J. If the pump controls are microcomputer based, all software and on-line field modified data entries, such as stage point, or method of staging, shall be stored in EEPROM to prevent accidental loss of data due to voltage surge or spike. In the event of a complete power outage, all factory preset data values remain stored and available for recall by the operator.
- K. The pump controls shall be capable of operation in ambient conditions of 0° C to 60° C and a humidity range of 5% to 95%, non-condensing.
- L. Any external sensors/transmitters and switches shall be powered by the pump control panel through its integral power supply. Overvoltage and short circuit protection shall be on-board.
- M. Booster pumps shall be single stage, end suction, horizontal or vertical close-coupled centrifugal-type pumps. The speed shall not exceed 3600 rpm. Pump casings shall be cast iron or ductile iron or steel and shall be rated for the pressure in the system with bronze bearing or sealing rings. Impellers shall be bronze, balanced to eliminate vibration, and shall be keyed to bronze shaft sleeves. Pumps shall be provided with mechanical seals. Pump bases shall be cast iron or steel with ribs and lugs and shall have a drip lip with drain hole. Casings shall have gauge ports and vent & drain ports at top and bottom of casing.
- N. Pump motors shall be high efficiency and shall be in accordance with Section 220050.
- O. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished

showing capacity, head, efficiency, brake horsepower, and operation in parallel. Multiple pump installations shall have pump characteristics compatible for operation in parallel.

P. Sequence of Operation

1. The lead pump shall operate at the point on its curve where system demand is satisfied. If the lead pump is unable to satisfy demand, the lag pumps shall be started as required.
2. As demand decreases, the lag pumps shall be destaged to minimize energy consumption.
3. In the event of a failure due to motor overload, the next pump in sequence shall be started.

PART 3 - EXECUTION

3.1 INSTALLATION OF PUMPS

- A. Install pumps, where indicated, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.
- B. Install in-line pumps per manufacturer's instructions, supported from piping system, located for access to oil cups, service, and maintenance.
- C. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.

3.2 INSTALLATION OF ELECTRIC WATER HEATERS

- A. Inspect unit and components for possible damage that may have occurred during shipment or storage. Check rating plate on unit for electrical requirements.
- B. Location: Locate the unit as near as possible to area of greatest hot water usage. A minimum of 18-inches clearance at sides and back shall be in front of unit of door swing and electric element removal.
- C. Electrical Connectors: Check rating plate on front for correct voltage, phase and amperage. Refer to wiring diagram and printed instruction sheet for control components mounted on heater. Use proper wire size and safety device as required by National Electrical Code and state and local codes.

3.3 INSTALLATION OF GAS HEATERS

- A. Location: Clean and dry location with a minimum of 18-inches clearance at sides and back and 48-inches in front of heater should be maintained for inspecting and servicing. Consult local codes for proper clearance. Central location is indicated in drawings.
- B. Installation: Inspect the water heater and burner for possible damage that may have occurred in shipping or during storage. Check the rating plate on the hot water heater and the burner.
- C. Venting: See HVAC section of specification.
- D. Electrical: Wiring to the unit should conform to the National Electrical Code and/or other locally authorized code.

- E. Securely anchor to floor and provide seismic restraints indicated in Section 220020.
- F. Provide a PVC drain line from the boiler flue with a neutralization kit in accordance with the manufacturers installation instructions and route to a floor drain.

3.4 SERVICE ENTRANCE

- A. Install shutoff valve at service entrance inside building; complete with strainer with blowdown valve, pressure gauge, and test tee with valve and pressure gauge.
- B. Install pressure regulating valve with inlet and outlet shutoff valves and balance cock bypass. Install strainer with blowdown valve, pressure gauge with gauge cock on reduced pressure side.
- C. Install backflow preventer at service entrance to building.

3.5 INSTALLATION OF WATER METER

- A. Install water meter in accordance with utility company's installation instructions and requirements.
- B. Size meter and arrange piping and specialties to comply with utility company's requirements.
- C. Set meter on concrete pad as indicated. Refer to Section 220010 for concrete and reinforcing requirements.
- D. Mount meter on wall brackets as indicated.

3.6 ROUGH-IN FOR WATER METER

- A. Install rough-in piping and specialties for water meter installation in accordance with utility company's instructions and requirements.

3.7 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. Provide valved bypass for operation of system during service. For connections 2-1/2 inch and larger, use flanges instead of unions.

3.8 INSTALLATION OF BACKFLOW PREVENTERS

- A. Install backflow preventers of type and capacity indicated, at each water supply connection to mechanical equipment and systems; to other equipment and systems indicated; and in compliance with the plumbing code and authority having jurisdiction.
- B. Valves shall be installed at not less than 12" above the floor with the maximum of 60" above floor.

- C. Provide strainer and stop valve upstream and stop valve downstream. Provide union to allow removal of backflow preventer.
- D. Provide a drain line with air gap fitting to nearest floor drain or other suitable termination point. Waste connection shall be a fixed air gap fitting with a threaded connection.
- E. Backflow preventers shall be full line size.

3.9 INSTALLATION OF PRESSURE REDUCING VALVES

- A. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.10 EXPANSION TANK INSTALLATION

- A. Install expansion tanks as indicated on the drawings and in accordance with the manufacturer's instructions. Support tank from the structure. Adjust precharge to 60 psig unless otherwise indicated on the plans.

END OF SECTION 220410

SECTION 220420 - PLUMBING FIXTURES AND TRIM**PART 1 - GENERAL****1.1 SCOPE**

- A. This section provides requirements for furnishing and installing water closets, mop sinks, lavatories, fixture carriers, floor drains and cleanouts.

1.2 RELATED WORK

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. For electrical connections to electric water coolers and other plumbing fixtures, not work of this section.

1.3 QUALITY ASSURANCE

- A. Plumbing Fixture Standards: Comply with applicable portions of National and Local Plumbing Codes pertaining to materials and installation of plumbing fixtures or equipment.
- B. ASSE 1016 (2005) - Automatic Compensating Valves for Individual Showers, Tub/Shower Combinations.
- C. ASSE 1017 (2009) - Temperature Actuated Mixing Valves for Hot Water Distribution Systems.
- D. ASSE 1069 (2005) - Automatic Temperature Control Mixing Valves.
- E. ASSE 1070 (2004) - Water Temperature Limiting Devices.
- F. ASSE 1071 (2008) - Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
- G. ANSI Z358.1 - Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
- H. NSF/ANSI 61 - Drinking Water System Components
- I. NSF/ANSI 372 - Drinking Water System Components - Lead Content

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 220000.
- B. Describe supports, components, accessories, and sizes.
- C. Data for inclusion in Operating and Maintenance Manual specified in Section 220000.

1.5 NSF COMPLIANCE

- A. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures individually wrapped in factory fabricated containers.
- B. Handle plumbing fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS**2.1 PLUMBING FIXTURES**

- A. General: Provide factory fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type is indicated, selection is Installer's option; but, all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations. Furnish faucets and supply stops with renewable monel seats. Lavatories and sinks shall have the correct number of holes to coordinate with the faucets and accessories indicated even if model number listed does not indicate the correct number of holes; contractor shall be responsible to properly coordinate the sink/lavatory with the faucet and accessories.
- B. The named manufacturer and model number establishes a reference for quality and design. The omission of other manufacturers' names and model numbers does not limit or exclude the use of their products.
- C. The following are acceptable substitute component manufacturers:

1. Vitreous China fixtures	American Standard, Sloan, Zurn, Toto and Kohler
2. Faucets	Symmons, Chicago, Delta, American Std., Grohe, Moen (commercial grade)
3. Drinking Fountains	Halsey-Taylor, Elkay, Haws, Oasis
4. Carriers, Drains, Cleanouts, Hose bibbs, Wall Hydrants	Woodford, Josam, JR Smith, Wade, Zurn, Watts, Prier, Mifab
5. Flush Valves	Sloan, Zurn
6. Sinks	American Standard, Just, Elkay
7. Mop Basin	Fiat, Swan, Willoughby
8. Shower Receptors	Aqua Bath, Lasco, Oasis
9. Emergency Eyewash	Guardian, WaterSaver
10. Emergency Shower	Guardian, Acorn
- D. Where battery operated fixtures are specified, contractor shall furnish and install batteries with the fixtures.

2.2 FIXTURES

- A. See Drawings for Schedule

PART 3 - EXECUTION

3.1 INSTALLATION OF FIXTURES

- A. Examine rough-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.

- B. Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.
- C. Caulk between fixtures and walls with white silicone caulking.

3.2 CLEAN AND PROTECT

- A. Clean plumbing fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during the remainder of the construction period.
- C. Plumbing fixture shall not be used for construction preparation or cleaning, unless written approval is given by the owner.
- D. Plumbing fixtures shall not be used by any contractor, unless written approval is given by the owner.
- E. Cover floor drains, floor sinks, shower drains, tub drains, and any open drain pipe to keep dirt and debris out of sanitary pipe during the entire construction period.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.4 INSTALLATION OF FLOOR DRAINS AND FLOOR SINKS

- A. General: Install floor drains and sinks in accordance with manufacturer's written instructions and in locations indicated.
- B. Install floor drains and sinks at low points of surface areas to be drained, or as indicated. Set tops of drains and sinks flush with finished floor.
- C. Install drain and sink flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

3.5 INSTALLATION OF CLEANOUTS

- A. General: Install in waste piping and storm piping as indicated and as required by National Standard Plumbing Code; at each change in direction of piping greater than 45 degrees; at minimum intervals of 50 feet for piping 4 inch and smaller and 100 feet for larger piping; and at base of each stack or conductor. Install floor and wall cleanout covers for concealed piping; select type to match adjacent building finish.
- B. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing thru waterproof membrane.
- C. Cleanout Size: 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.

3.6 HYDRANT INSTALLATION

- A. Install all hydrants in accordance with manufacturer's instructions and approved product data submittals and in accordance with details on the plans. Where manufacturer's instructions and plan details conflict, follow the more stringent requirement.
- B. Install non-freeze wall hydrants in walls of sufficient stem length to prevent freezing when the hydrant is turn off. Locate wall hydrants so valve
- C. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- D. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- E. Install non-freeze, non-draining type post hydrants set in concrete or pavement.
- F. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

3.7 TRAP PRIMER INSTALLATION

- A. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of 1/8 inch per foot and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.8 EXPANSION TANK INSTALLATION

- A. Install expansion tanks as indicated on the drawings and in accordance with the manufacturer's instructions. Support tank from the structure. Adjust precharge to 60 psig unless otherwise indicated on the plans.

END OF SECTION 220420

SECTION 220430 - DOMESTIC WATER SOFTENERS**GENERAL****1.1 SCOPE**

- A. Install the water softener where shown on the contract drawings per the mnfg. installation requirements.
- B. All work shall be in accordance with the local plumbing code, the requirements of the Building Code and the Seismic requirements defined in Section 220020 and with seismic details on drawings. If any of these documents are in conflict with the local code authority, the discrepancy shall be noted by the Contractor and sent to the Engineer prior to initiating any work.
- C. Section Includes:
 - 1. Commercial water softeners.
 - 2. Chemicals.
 - 3. Water-testing sets.

1.2 RELATED DOCUMENTS

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

- B. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
 - 1. Section 220000 - Plumbing General Conditions.
 - 2. Section 220010 - Basic Plumbing Materials and Methods.
 - 3. Section 220020 – Seismic Restraints.
 - 4. Section 220400 - Plumbing Systems.
 - 5. Section 220410 - Plumbing Equipment.
 - 6. Section 220420 - Plumbing Fixtures and Trim.

1.3 PERFORMANCE REQUIREMENTS

Seismic Performance: Water softeners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water softeners.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Wiring Diagrams: For power, signal, and control wiring.

Seismic Qualification Certificates: For water softeners, accessories, and components, from manufacturer.

- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra salt for the brine tanks.
 - 1. Salt shall:
 - a. Match products installed.
 - b. Be packaged with protective covering for storage and identified with labels describing contents.
 - c. Be delivered and stored on raised platform or pallets according to the following:
 - 1. Food-Grade pellet salt: In 40 or 50-lb packages.
 - 2. Plain pellet salt: In 40 or 50-lb packages.
 - 2. Do not store in contact with concrete floor.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.

ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.

- C. UL Compliance: Fabricate and label water softeners to comply with UL 979, "Water Treatment Appliances."

1.8 COORDINATION

Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures of mineral and brine tanks.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - d. Attrition loss of resin exceeding 3 percent per year.
 - e. Mineral washed out of system during service run or backwashing period.
 - f. Effluent turbidity greater and color darker than incoming water.
 - g. Fouling of underdrain system, gravel, and resin with turbidity or by dirt, rust, or scale from water softener or soft water, while operating according to manufacturer's written operating instructions.

Commercial Water Softeners, Warranty Period: From date of Substantial Completion.

- a. Mineral Tanks: Five years.
- b. Brine Tanks: 10 years.
- c. Control Valve: One year.

1.10 MAINTENANCE SERVICE

Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of water softener Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper water softener operation at rated capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

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.

PART 2 - PRODUCTS

2.1 COMMERCIAL WATER SOFTENERS

Description: Factory-assembled, pressure-type water softener.

1. Available Manufacturers:
 - a. Culligan International Company.
 - b. Marlo, Inc.
 - c. Alamo Water Treatment; Ecodyne Water Treatment.
 - d. Kinetico Incorporated.
 - e. Water Soft, Inc.

B. Description: Factory-assembled, pressure-type water softener.

Standard: Comply with NSF 61 Annex, "Drinking Water System Components - Health Effects."

2. Configuration: Reference schedule on drawings for **unit and tank configuration and quantities**.
3. Mounting: On skids.

Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F.

Mineral Tanks: FRP, pressure-vessel quality.

- a. Construction: **Non-ASME code**.

Pressure Rating: 125 psi minimum, 150 percent minimum for backwash expansion above normal resin bed level.

- d. Support Legs or Skirt: Constructed of structural steel, welded to tank.
- e. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
- f. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, non-clogging plastic strainers, and arranged for even flow distribution through resin bed.

Liner: PE, ABS, or other material suitable for potable water.

Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressure; does not require field adjustments.

Meter Control: Each mineral tank is equipped with signal-register-head water meter that produces electrical signal indicating need for regeneration on reaching hand-set total in gallons. Signal will continue until reset.

Demand-Initiated Control: A solid-state programmable microprocessor controller shall be furnished and be capable of operating up to three softener vessels in either a parallel, alternating or additive flow configuration. Each mineral tank of multiple mineral-tank unit is equipped with automatic-reset-head

water meter that electrically activates cycle controllers to automatically regenerate at preset total in gallons. The controller shall have a digital display for the volume batch, volume remaining, continuous flow rate, peak flow rate and totalization for up to three softener units. Head automatically resets to preset total in gallons for next service run. Electrical lockout prevents simultaneous regeneration of more than one tank.

Brine Tank: Combination measuring and wet-salt storing system.

- a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
 - b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawal and freshwater refill.
 - c. Size: Large enough for at least four regenerations at full salting.
8. Factory-Installed Accessories:
- a. Piping, valves, tubing, and drains.
 - b. Sampling cocks.
 - c. Main-operating-valve position indicators.
 - d. Water meters.

Capacities and Characteristics – Reference the schedule on the drawings.

2.2 CHEMICALS

- A. Mineral: High-capacity, sulfonated-polystyrene, ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

Exchange Capacity: 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.

- B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.

1. Form: Processed, food-grade salt pellets, plain salt pellets.

2.3 WATER-TESTING SETS

- A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.4 SOURCE QUALITY CONTROL

- A. Hydrostatically test mineral tanks before shipment to a minimum of one and one-half times the pressure rating.
- B. Prepare test and inspection reports.

PART 3 - EXECUTION**3.1 WATER SOFTENER INSTALLATION****A. Equipment Mounting:**

Install commercial water softeners on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in "Cast-in-Place Concrete."

Comply with requirements for vibration isolation and seismic control devices specified in Section 220020 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure.

- C. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.
- D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- E. Install water-testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.2 CONNECTIONS

Comply with requirements for piping specified in Section 220400 "Plumbing Systems."

- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where piping is installed adjacent to equipment, allow space for service and maintenance of equipment.
- D. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.
 - 1. Valves are specified in Section 220400 "Plumbing Systems."

Exception: Water softeners with factory-installed shutoff valves at locations indicated.

- E. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Section 220400 "Plumbing Systems."

Exception: Water softeners with factory-installed pressure gages at locations indicated.

Exception: Water softeners in hot-water service.

- F. Install valved bypass in water piping around water softeners.
 - 1. Valves are specified in Section 220400 "Plumbing Systems."
 - 2. Water piping is specified in Section 220400 "Plumbing Systems."
 - 3. Exception: Water softeners in hot-water service.

- G. Install drains as indirect wastes to spill into open drains or over floor drains.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220400 "Plumbing Systems."

3.4 FIELD QUALITY CONTROL

Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Water softeners will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Add water to brine tank(s) and fill with commercial water softener processed salt of plain salt pellets.
- B. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
 1. ASTM D 859, "Test Method for Silica in Water."
 2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
 3. ASTM D 1068, "Test Methods for Iron in Water."
 4. ASTM D 1126, "Test Method for Hardness in Water."
 5. ASTM D 1129, "Terminology Relating to Water."
 6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water softeners.

3.7 Additional Product

- A. Provide additional salt in same form as startup.
- B. Provide 4x the original load, but not less than 200 lb.

END OF SECTION 220430

SECTION 220450 - INTERCEPTORS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Provisions of General Conditions and Section 220000, PLUMBING GENERAL CONDITIONS are a part of this Section of these specifications.
- B. All equipment shall be installed in compliance with manufacturer's recommendations.

1.2 SUMMARY

- A. Extent of interceptors work is indicated on drawings and provisions of this section.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Materials and Methods.
- D. Section 220400 - Plumbing Systems.
- E. Section 220440 - Foundation Drainage Systems.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. The following are acceptable component manufacturers:
 - 1. Inside interceptors: JR Smith, Wade, Zurn, Rockford, Schler
 - 2. Outside interceptors: Champion Products, Schier, or equal
- B. See schedule on drawings.

2.2 (OIL AND) GREASE INTERCEPTORS (OUTSIDE)

- A. General: Provide (oil and) grease interceptors, of size and capacity as indicated.
- B. Construction: Traffic rated concrete interceptor.
- C. Variations: Provide the following construction feature variations:
 - 1. 6" inlet and outlet
 - 2. 24" dia. riser with Man-hole cover
 - 3. 6" dia. hole on top for clean out purposes
 - 4. mastic sealed

2.3 SAND INTERCEPTORS (OUTSIDE)

- A. General: Provide sand interceptors, of size and capacity as indicated.
- B. Construction: (Non-) Traffic rated concrete interceptor.
- C. Variations: Provide the following construction feature variations:

1. 6" inlet and outlet
2. 24" dia. riser with Man-hole cover
3. extra clean-out hole

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas and conditions under which interceptors are to be installed, and substrate which will support interceptors. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF INTERCEPTORS

- A. General: Install interceptors as indicated, in accordance with manufacturer's installation instructions, and in compliance with applicable codes.
- B. Excavate for all underground work that requires excavation. See Section 220010 of this specification for excavation and backfill requirements.
- C. Support: Anchor interceptors securely to substrate; locate so adequate clearance is provided to remove covers and sediment baskets. Set recessed units so top of cover is flush with finished floor.
- D. Set interceptor so top of man-hole is flush with grade.
- E. Piping: Connect inlet and outlet piping to interceptors.

3.3 PROTECTION

- A. Protect interceptors during remainder of construction period, to avoid clogging with construction materials and debris, and to prevent damage from construction debris and traffic.

END OF SECTION 220450

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SECTION 230000 – MECHANICAL GENERAL CONDITIONS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 230000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The mechanical work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "Contractor" as used in these specifications shall mean the person, firm or corporation contracting to do the described work.
- E. It shall be a part of this Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.
- F. Rough-in for and connect, as shown on the drawings, facilities for equipment furnished by the Owner under a separate contract.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes:

Kentucky State Building Code – 2018
Kentucky State Plumbing Code – 2020
Kentucky State Mechanical Code – 2015
Kentucky State Energy Conservation Code – 2012
Kentucky State Storm Shelter Code – 2014

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, site, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every

respect. Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.

- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this Contractor. Ductwork, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all duct, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as curbs and sealing, etc., which are not shown on the plan view. This Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to ensure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.
- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for

changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.

- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. This Contractor, before submitting bid, shall visit the site and become thoroughly acquainted with conditions under which the work will be performed.
- B. Failure to become fully acquainted with existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract.

1.7 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations.

1.8 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General and Special Conditions. Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to:

SSC Engineering
Attention: Submittals
18207 Edison Ave.
Chesterfield, MO 63005
 - 4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".
- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's

sole use. The Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the Contractor marked accordingly.

- E. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- F. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
- G. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this Contractor.
- H. Shop drawings shall include the plan mark used on the plans.
- I. Valve and fitting shop drawings shall indicate the intended service.
- J. Equipment shop drawings shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- K. Submittals which do not provide the required information will be returned unchecked.
- L. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- M. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- N. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

1.9 RELEASE OF CAD FILES

- A. See "Release of CAD Files" at the end of this section.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed.

The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

- B. Contractor shall also submit four (4) complete hard copy sets and one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
1. Include a Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 2. Complete set of shop drawings.
 3. Copies of all submittals.
 4. Parts lists, wiring diagrams, piping diagrams, etc.
 5. Manufacturers' operating and maintenance instructions.
 6. As-built drawings.
 7. Written operating and maintenance instructions for the system. This is a written version of Paragraph "1" above.
 8. Copies of warranties.
 9. Parts lists for each piece of equipment and name of local supplier.

1.11 AS-BUILT RECORD DRAWINGS

- A. During construction, a separate set of plans at the jobsite shall be maintained by the Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of piping, ductwork and other concealed facilities are to be shown by the Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the contractor in CAD format, contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 GUARANTEE AND WARRANTY

- A. This Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year in accordance with the General Conditions. This one-year warranty shall commence on satisfactory completion of final punch list items. Satisfactory completion of the final punch list will be determined by the Engineer. If the Owner accepts a portion(s) of the project earlier than the rest, such as partial beneficial occupancy, that portion's warranty shall begin on the date it is accepted as substantially

complete. A project may have multiple warranty periods in these certain cases and will be fully coordinated between the Owner, the Architect and the Engineer.

- B. During the guarantee period, this Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
 - 1. For manufacturers other than those listed, the Contractor shall prepare and submit to the Architect/Engineer for review, a proposal to provide a substitution. Proposal shall be submitted minimum ten (10) working days before the bid date and written approval shall be received from the Architect/Engineer before including the substitution in the bid. Substantiate that the substitution complies with the intent of the Project Documents and include sufficient information of the changes required so that a judgment may be rendered.
 - 2. Proposal shall include a drawing originated by the Contractor. The design shall show the intended installation to the same level of detail as that of the original design in addition to catalog cut, assembly manual, or other generic documents printed by the manufacturer or their representative.
 - 3. Prior to submitting the proposal, the Contractor shall notify all other contractors whose work is affected and request details and pricing of their respective changes. This information along with the Contractor's details shall be transmitted to the Architect/Engineer for approval.
 - 4. If the proposal is accepted, the Contractor shall compensate other trades which are affected by said proposal.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.
- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this Contractor's bid. This contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.
- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.

- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Contractor shall provide all material, equipment, labor, services, and supplies, required to execute all work shown on the mechanical drawings; described in these specifications; or made necessary by the work shown on the drawings and/or described in these specifications.
- B. Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. If Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall provide power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be provided by the Temperature Control Contractor. Unless noted otherwise, the control wiring shall be provided by the Contractor furnishing the controlled equipment.
- F. Unless noted otherwise, the Electrical Contractor shall provide all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a part of a factory-assembled package. Heater elements for overload relays on magnetic motor starters (except the starters factory pre-wired with equipment) shall be sized, furnished and installed by the Electrical Contractor. Magnetic motor starters for mechanical equipment (except starters factory pre-wired with equipment such as chillers and packaged air conditioners) shall be provided by the Electrical Contractor. Magnetic motor starters will be provided with:

1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
 2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.
- G. Each Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized heater elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.
- H. Unless specifically noted otherwise, pilot controllers (aquastats, flow switches, pressure switches, etc.) shall be furnished and mounted by the Contractor furnishing the controlled equipment.
- I. Unless specifically noted otherwise, thermal wells for temperature control system sensors shall be provided by the Temperature Control Contractor and installed by the Mechanical Contractor.
- J. Unless specifically noted otherwise, control valves and control dampers shall be furnished by the Temperature Control Contractor and installed by the Mechanical Contractor.
- K. Electrical Work For Mechanical Equipment: Electrical Contractor shall wire all mechanical equipment furnished by various contractors in accordance with the following general provisions:
1. Power wiring from panel to motor controllers, relays, etc., and from controller to motor terminals per equipment manufacturer's wiring diagram.
 2. Receive, unload, set and align all separately shipped motors.
 3. Field lubricate all separately shipped motors prior to initial operation of same.
 4. Install individual motor starters specifically called for to be furnished by other Contractors when not a factory pre-wired component.
- L. HVAC Contractor shall provide the following:
1. All motors, disconnect switches or control devices specifically called for.
 2. Automatic control and interlock wiring diagrams as called for in the specifications.
 3. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical power wiring including motor terminal connection diagrams.
 4. Adjustable motor bases and all bolts and nuts required for installation of base and motor. Adjust and align drives and adjust belt tension.
 5. Supervision of Electrical Contractor in lubrication of motors to eliminate possibility of motor starting or operating without proper lubrication and control systems.
- 3.3 PROTECTION OF EQUIPMENT AND WORK
- A. This Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.

- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This Contractor shall cooperate with and coordinate to plan and schedule the work to satisfy the schedule.
- B. All work shall be so arranged that electrical power, sewer, water, and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.
- C. All interruptions shall be scheduled and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.
- D. Ducts which are shown to be installed or demolished in subsequent phases that are needed for earlier phases to make the earlier phase operational shall be installed or demolished in the earlier phase during non-business hours. Any diffusers that straddle phase areas shall be temporarily moved to the adjacent ceiling to remain in service and shall be permanently moved to the correct location before substantial completion. Where later phase work is performed in an earlier phase, contractor shall remove and replace ceilings as required to perform the work.

3.5 DEMOLITION OF FACILITIES

- A. General
 - 1. The demolition work shall consist of removal and/or relocation of mechanical equipment, ductwork, and related piping pertaining to the installation and modifications of the heating, ventilating and air conditioning systems as indicated on the drawings.
 - a. Piping to Be Removed: Drain piping and remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Ducts to Be Removed: Remove portion of ducts indicated to be removed to an existing joint in the duct, unless otherwise indicated, and cap remaining ducts with same or compatible ductwork material or cap with polyethylene film sealed to duct with duct tape.
 - d. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - e. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - f. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

- g. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - 2. Contractor shall note the project is a renovation to an existing building. Contractor shall allow adequate overtime and supervision to allow for work that is required by the owner to be performed after normal operating hours.
 - 3. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. The Contractor shall be responsible to field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.
 - 4. Contractor shall review the drawings, specifications and existing job conditions and shall include in his bid all demolition work as required and as shown on the mechanical drawings.
 - 5. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
 - 6. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.
 - 7. All mechanical equipment to be reused shall be disconnected, marked and protected where necessary.
- B. Existing Conditions
- 1. Contractor shall exercise great caution when performing demolition work to prevent damage to existing systems or items of work that are to remain. If Contractor damages, removes or destroys an existing system which is to remain, Contractor shall repair or replace that system to its original condition.
 - 2. Unless specifically stated otherwise on the plans, where access to mechanical, plumbing, and fire protection items is required, Contractor shall provide the required access by removing ceilings, cutting openings, etc., as required. Prior to cutting openings, this Contractor shall outline the openings and shall obtain approval from and shall cut openings in the manner directed by the General Contractor. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.
 - 3. Repair of openings is a part of this Contractor's work. Work shall be performed by the proper trades. Materials which are removed, damaged, or soiled shall be replaced with new materials. Ceilings and walls shall be repaired and restored to as close to the original condition as possible. This shall include replacement of surface finish materials such as paint, plaster, drywall, ceiling tile, etc.

4. Repair of floor openings and trenches is a part of this Contractor's work. Floors shall be repaired to match the level and surface finish of the existing concrete and flooring finishes.
5. Areas shall be repaired with materials matching those which have been removed.
6. Contractor shall repair streets, sidewalks, parking lots and reseed grassed areas which have been altered by his work.

C. Protection

1. During demolition operations, all persons and property shall be protected. This Contractor shall be responsible for the erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.
2. Contractor shall minimize any spread of dust, debris and flying particles. Demolition shall not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, this Contractor shall provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. Disposition of Material

1. Those items of material and equipment to be removed by this Contractor and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner.
2. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

E. Hazardous Materials

1. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work. Hazardous materials will be removed by Owner before start of the Work. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect, Engineer, and Owner. Owner will remove hazardous materials under a separate contract.
2. Where insulation containing hazardous materials is removed from piping and equipment, it shall be replaced with new insulation. See specification 230200, Mechanical Insulation.

3.6 RELOCATION OF EXISTING EQUIPMENT

- A. Some items of existing equipment are to be relocated as indicated on the drawings. All utility connections in the existing location shall be disconnected by this Contractor. This Contractor shall reconnect the utility in the new location. These utilities include electric and piping. The equipment shall be moved from the existing location to the new location as indicated on the drawings.

- B. Unless otherwise indicated, equipment shall be relocated in the condition in which it exists before relocation begins. This Contractor is not responsible for reconditioning existing equipment unless otherwise indicated. Prior to disconnecting any utilities and prior to placing the equipment out of service, this Contractor shall, in the presence of the Owner's Representative, inspect all items or equipment scheduled for relocation and shall document deficiencies which might affect this Contractor. After the equipment is in place in its new location, it shall be the responsibility of this Contractor to reconnect the utilities and place the equipment into proper operation.
- C. This Contractor shall be responsible for damage done to the equipment during relocation. Except for the documented deficiencies, all deficiencies shall be considered to have occurred during relocation, in which case this Contractor shall repair or replace at no additional cost to the Owner.

3.7 MAINTENANCE OF WORK AREAS

- A. During the project, this Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.
- B. Open ends of pipe, ductwork, equipment, and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.8 CLEANING AND CLEANUP

- A. Upon completion of this work, the Contractor shall clean all pipe, ductwork, fixtures, and equipment. Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. Each contractor shall be responsible for his own cleanup to a central location designated by the General Contractor. Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work.

END OF SECTION 230000

RELEASE OF CAD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2023. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CAD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

Company

Version of AutoCAD used

Name (Must be an officer of the Company)

E-mail address

Title

Maximum e-mail attachment size

Date

SECTION 230010 – BASIC MECHANICAL MATERIALS AND METHODS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. This section covers basic mechanical materials and methods for the systems listed below and applies to work of those sections. Provide Basic Mechanical Material and Methods as indicated and required.

1. Mechanical

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.

PART 2 - PRODUCTS**2.1 PRODUCT CRITERIA**

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association

HEW	U.S. Department of Health, Education and Welfare
PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation
IEEE	Institute of Electrical and Electronic Engineers
AWWA	American Water Works Association

- C. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

2.3 PREFABRICATED ROOF CURBS

- A. Prefabricated curbs shall be heavy-gage, galvanized steel with mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Provide 14 inches high where no other height is indicated. Curbs shall be Thycurb TC-3 for roof decks that are not surface insulated, and Thycurb TC-1 for decks that are surface insulated.
- B. Equivalent products, complying with these specifications, by the following manufacturers are acceptable:
1. Pate
 2. Thybar
 3. Roof Products & Systems

2.4 PREFABRICATED ROOF MOUNTING RAILS

- A. Equipment not designed for curb mounting, but requiring roof supporting shall be installed on mounting rails, Thycurb TEMS 1. Mounting rails shall be constructed of galvanized sheet metal, all welded construction, with wooden nailer, cant strip and weatherproof cap. Mounting rails shall be selected for point or uniform loading as determined by the equipment being supported and for the space between structural members. Rails shall span at least two joists or beams, and shall not cantilever joists or beams more than 6". If cantilever is greater than 6", rail length shall be increased to span to next structural member.
- B. Equal products, complying with theses specifications by the following manufacturers are acceptable:
1. Pate
 2. Thybar
 3. Roof Products & System

2.5 PREFABRICATED PIPE SEALS

- A. Seals for Roof Penetrations
1. Prefabricated pipe seals shall have a one piece spun aluminum base with a 5" high roof surface flange sloped for runoff. Unit shall have a PVC boot with graduated widths and adjustable stainless steel clamps. Unit shall withstand expansion, and vibration and

shall fit pipe sizes from 1/2" through 10" to be heavy-gage, galvanized steel curb with mitered and welded corners; 1-1/2-inch-thick

2. Equal products, complying with these specifications by the following manufacturers are acceptable:
 - a. Pate
 - b. Roof Products & Systems
 - c. Thycurb
 - d. Approved Equal

B. Seals for Floor or Foundation Wall Penetrations

1. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

2.6 PREFABRICATED PIPE STANDS

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - d. Or Equal

- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

2.7 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.8 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.

- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.9 ACCESS PANELS SHALL COMPLY WITH THE FOLLOWING

- A. Access panels shall be constructed of heavy gauge steel with factory applied prime coat of baked enamel.
- B. Panel doors shall be attached to the frame with concealed hinges.
- C. Cam locks shall be provided in not less than the following quantities:

Panel Height (Opposite side of hinges)

0 to 18"	1 cam lock
18-1/16" to 30"	2 cam locks
30-1/16" to 48"	3 cam locks
48-1/16" to 60"	4 cam locks

Panel Width

0 to 18"	No cam locks on top or bottom
18-1/16" to 30"	1 cam lock top and bottom
30-1/16" to 48"	2 cam locks top and bottom

- D. On the panel height, one of the cam locks described above shall be a key operated cylinder lock in lieu of the cam lock. One key shall operate all panels.
- E. Cam locks shall have tamper-proof heads. Provide 10 tools to the owner.
- F. For masonry, tile or wallboard surfaces, provide access panels with extruded aluminum frames, 3/4" border, aluminum piano hinges, screwdriver-operated cam lock, brushed satin aluminum finish. Final painting to match interior decor by others. Paintable finish to be provided when the adjacent construction is paintable.
- G. Access panels will not be required in accessible type ceilings.
- H. For plastered ceiling or wall, concealed flange, recessed door panel to receive plaster by others, continuous hinges, flush latch, white prime coat finish. Final painting to match interior decor by others.
- I. For Fire Rated Partition - Access doors in fire rated walls shall be 1-1/2 hour (B) rated and shall bear the UL label. Doors shall be fabricated of steel and shall be provided with baked enamel prime coat over a phosphate coating. Doors shall be Milcor or approved equal.
- J. For locations concealed from public, snap catch latches may be used.
- K. Manufacturer - Panels shall be equal to Inryco/Milcor type K for plaster, type DW for drywall, type M for masonry.

2.10 SLEEVES

- A. Exterior And Foundation Walls:

1. All piping through exterior walls, new concrete walls, or new foundation walls shall pass through sleeves which shall be large enough to allow for caulking and sealant materials. No sleeves shall be permitted through concrete structural members unless indicated on the structural drawings or approved by the Structural Engineer. Sleeves shall be cut smooth and flush with each side of the wall.
 - a. Sleeves above grade shall be Schedule 40 PVC pipe.
 - b. Sleeves below grade shall be cast iron or Schedule 40 PVC pipe.
 2. All piping passing through existing concrete or foundation walls shall pass through core drilled holes which shall be large enough to allow for caulking material.
 3. All duct openings through exterior walls shall be sleeved with 20 gage galvanized steel sheet metal with flanges turned away from the opening on both sides unless otherwise indicated on the drawings. Space between sleeve and duct shall be packed with fiberglass and sealed on both sides.
- B. Interior Walls And Partitions:
1. Fire Rated Walls:
 - a. Piping through fire rated interior walls and partitions shall pass through either Schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves (18 gauge sheet metal sleeves shall be installed if required by the U.L. classification). Schedule 40 steel pipe sleeves shall be used when required for structural purposes. Sleeves are not required for automatic control tubing.
 - b. Duct through fire rated interior walls and partitions shall be connected to sleeves with fire dampers. See section 230900, Air Distribution.
 2. Non Rated Partitions:
 - a. Concealed Locations: Sleeves are not required for piping or ducts unless otherwise indicated on the drawings.
 - b. Visible Locations except in boiler, utility, or equipment rooms:
 - 1) Openings between duct and wall shall be covered with 24 gage galvanized steel sheet metal angles to form an escutcheon over the opening.
 - 2) Openings between pipes and wall shall be covered with escutcheons. Where required, special deep-type escutcheons shall be used. Escutcheons shall be chrome plated, one-piece or split-pattern, and secured in place.
 3. Mechanical Room Walls and other locations indicated on the drawings: Duct openings shall be sleeved with 22 gauge galvanized steel sheet metal with flanges turned away from the opening on both sides. Space between sleeve and duct shall be packed with fiberglass and sealed on both sides.
- C. Floors:
1. Piping through floors shall pass through schedule 40 carbon steel pipe sleeves, extending from the bottom of the slab to 2 inches above floor.

2. For existing concrete floors an oversized hole shall be core drilled. A flange shall be welded to the outside of the sleeve and the sleeve grouted in place. See details on the plans.

2.11 BACKING & SEALANTS

- A. Backing and sealant for piping and ducts passing through floors, plaster ceilings, partition, and walls shall be as follows:

1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
2. Sealant: Gun Grade. A 1-part neutral- and basic-curing Silicone sealant, "790" by Dow Corning Corporation; "Spectrem 1 (Basic)" by Tremco, or SilPruf LM SCS2700 by GE Silicones.
3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.
4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following: 1) "SpecSeal" by Specified Technologies Inc. 2) 3M, 3) Chase Technology Corporation, 4) Link-Seal, 5) Pyro-Pac by Thunderline Corporation, 6) "Fyre Seal" by Tremco, 7) Pensil 100 by General Electric, 8) Pensil by STI, or 9) "Flameseal" by G. S. Nelson Electric.
 - a. Acrylic 1-part silicone rubber, gun applied, fire retardant elastic sealant, "Fyre Seal" by Tremco.
 - b. Silicon foam sealant, CTC PR-855 by Chase Technology Corporation.
 - c. Fire stop putty. "Flameseal" by G. S. Nelson Electric.
 - d. Intumescence Sealant (SpecSeal SSS100) shall be one-part, two stage intumescent latex compound, expands a minimum of 8 times when exposed to 230°F to >1000°F, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, red in color, and safe for contact with plastics.
 - e. Flexible Sealant (SpecSeal LC150) shall be one-part, latex-based compound, flexible and non-shrinking when dry, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, blue in color, and safe for contact with plastics.

- f. Flexible Silicone Sealant (SpecSeal Pensil 300) shall be one-part, neutral curing silicone, completely water resistant, contain no solvents nor inorganic fibers, allow movement of +/-50%. Sealant shall be auto-bonding, ozone and UV resistant, chemical resistant and capable of caulking or troweling on to vertical surfaces or overhead.
- g. Intumescence Putty (SpecSeal Firestop Putty) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- h. Putty Pads (SpecSeal Firestop Putty Pads) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- i. Pillows (SpecSeal Firestop Pillows) shall be an intumescent pillow heat sealed in a fire-retardant poly bag with a monolithic core encapsulated by flexible intumescent coating and shall expand when exposed to 230°F to >1000°F.
- j. Mortar (SpecSeal Firestop Mortar) shall be light weight, fast drying, portland cement based, wet mortar density shall be ≤ 52 lb./cu.ft., dry mortar density shall be ≤ 45 lb./cu.ft., approved for combustible and noncombustible penetrants, have chemical adhesion, and be red in color.
- k. Silicone Foam (SpecSeal Pensil Silicone Foam) shall be two-part, silicone, room temperature curing foam, completely water resistant, contain no solvents nor inorganic fibers, allow movement of expansion, contraction and vibration.
- l. Intumescent Collars (SpecSeal Firestop Collar) shall be factory assembled collar utilizing a molded two stage flexible intumescent insert, insert shall expand a minimum of 15 times when exposed to 230°F to >1000°F, suitable for CPVC, ABS, ABS Foam Core, and FRPP pipes.
- m. Intumescent Wrap Strips
 - 1) (SpecSeal Firestop Red Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 15 times when exposed to 230°F to >1000°F.
 - 2) (SpecSeal Series Blu Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 30 times when exposed to 230°F to >1000°F.
- n. Intumescent coatings (SpecSeal Cable Coating) shall be water based, intumescent coating, expand a minimum of 5 times its dry applied thickness, flexible, water and weather-resistant film, contain no solvents or inorganic fibers. Coating shall be thixotropic and be capable of being applied by brush application or by airless spray.

o. Urethane Joint Sealants

1) Subject to compliance with requirements, provide one of the following:

- a) Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
- b) Polymeric Systems, Inc.; PSI-901.
- c) Approved equal.

5. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

2.12 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.13 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, boxes, panels, ducts, etc., shall be furnished and installed by the Contractor requiring the opening.
- B. Lintels furnished shall be ASTM A 36 structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.14 CUTTING

- A. Each Contractor shall be responsible for any cutting required for openings for conduits, pipes, ducts, etc., if sleeves or openings are not otherwise provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.
- B. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as glazed tile, wood paneling, etc., each contractor shall obtain the Owner's approval in advance of the cutting and patching.

2.15 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching.
- C. Surfaces with finishing materials such as tiled, paneled, stone or marble surfaces - Patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching.

2.16 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be by Allen Systems, Inc., W.H. Brady Co.- Signmark Div., Industrial Safety Supply Co., Inc. or equal.
- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.
- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers with ½" high letters. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name, 2) Tag Number, and 3) Equipment Service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.17 UNDERGROUND PIPING MARKERS

- A. Tape: Triple-laminate, consisting of aluminum foil, polyester film, and polyethylene, 6" wide.
- B. Colored background, black lettering, two lines wide, and 2" tall letters. Provide different color tape for each piping service.
- C. Acceptable Manufacturer, subject to compliance with requirements: Panduit Corporation.

2.18 CEMENT GROUT

- A. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

2.19 CONCRETE

- A. Reinforcing Materials
 - 1. Reinforcing and Joint Dowel Bars: Deformed steel bars, ASTM A 615, Grade 40, unless otherwise indicated. Furnish metal expansion caps for one end of each dowel bar. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1" unless otherwise indicated.
 - 2. Welded Wire Mesh: Welded plain cold-drawn, ASTM A 185. Furnish in flat sheets, not rolls.
- B. Concrete Materials

1. Portland Cement: ASTM C 150, Type II with tricalcium aluminate content of less than 5%.
2. Coarse aggregate shall be clean, hard, durable, uncoated limestone conforming to ASTM C-33. Use size "67" throughout with no more than one percent flint and chert by weight (i.e., when the amount of flint and chert are added together, this quantity shall be less than 1% of the coarse aggregate weight).
3. Water: Potable.
4. Air-Entraining Admixture: ASTM C 260.
5. Water-Reducing Admixture: ASTM C 494, Type A.
6. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

C. Proportioning and Design of Mixes

1. Prepare design mixes for concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility for preparing and reporting proposed mix designs. The testing facility may be the same as used for field quality control testing.
2. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
3. Design mixes to provide normal weight concrete with the following properties:
 - a. 4000 psi 28-day compressive strength.
 - b. 4,500 psi 28-day compressive strength at exterior locations where snow maintenance will be utilized.
4. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures

1. Use air-entraining admixture. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:
 - a. Interior 2 - 4%.
 - b. Exterior 4.5 – 7.5%.
2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

E. Slump Limits

1. Proportion and design mixes to result in concrete slump at point of placement at not less than 2" and not more than 4".

2.20 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall provide all bases, concrete inserts, anchor bolts, and structural steel to support the equipment, ductwork, piping, etc. installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Provide concrete housekeeping pads a minimum of 3-½" high, unless detailed otherwise, under all equipment, pumps, etc., in equipment rooms that have piping containing water. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be ½" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment.
- D. Provide prefabricated roof curbs or rails for roof mounted equipment except where otherwise indicated on the drawings.
- E. Curbs and rails shall be set on the roof structure and shall have a vertical insulation stop equal to the thickness of the roof insulation. (Field verify insulation for each curb and rail.) Install roof curbs and rails level and plumb, in accordance with manufacturer's written instructions. Coordinate with other elements of the work, including installation of roof deck, substrates, vapor barriers, roof insulation, roofing and flashing, as required to insure that the roof system is waterproof and weather tight.

1. Anchor curbs and rails securely to supporting structural substrates with bolts or by welding, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
2. Secure equipment to roof curbs with cadmium-plated screws or bolts or hardware approved by the Engineer. Install 3/8" thick sponge type gasket on top of curb to seal gaps between equipment and curb, unless otherwise approved by the Engineer.

3.2 PIPE STAND INSTALLATION

- A. Pipe Stands: Details on the drawings show a low type support. In general, provide this type. Where the elevation of the roof changes or where the piping is required to slope, provide an adjustable type support that can accommodate the different support heights needed to maintain the proper pipe elevation above the roof.
- B. Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Apply adhesive indicated on drawings between base and roof.

3.3 PIPE AND DUCT PROTECTION DURING CONSTRUCTION

- A. Protect pipe and duct interiors with plastic plugs or plastic sheeting during construction to protect from moisture, construction debris and dust, and other foreign materials.

3.4 DRIVE AND COUPLING GUARD

- A. Contractor shall provide coupling or belt guards on all drives which do not have guards factory installed. Belt guards shall enclose drive on all sides, shall have a hole for making tachometer readings, and shall comply with requirements of governing agencies including OSHA.

3.5 CUTTING AND PATCHING

- A. All cutting necessary for installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut. No openings shall be cut without written approval of the General Contractor.
- B. Before cutting or drilling holes in floors, verify the location of reinforcing steel bars and embedded electrical conduits to avoid cutting same. X ray floors where necessary to verify such locations. Contact the Engineer before proceeding with cutting if such obstructions interfere with the locations of planned holes.

3.6 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.7 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair. Provide access panels where indicated or required.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor whose equipment requires access shall provide access panels.
- C. Contractor shall obtain approval of Architect/Engineer of location of access panels that are not indicated on plans.

3.8 PAINTING

- A. All pieces of mechanical equipment shall be factory finished machinery-grey or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.
- B. All sheet metal plenums that are visible through an air device shall have the inside of the plenum painted flat black.
 - 1. This Contractor shall paint the following items:
 - 2. Items specified under "Demolition and restoration of facilities", Section 230000 shall be painted.
 - 3. Paint ductwork visible behind air outlets and inlets matte black.
 - 4. Paint exterior natural gas piping that is above grade; primer plus one coat yellow enamel.
 - 5. All uninsulated piping installed outdoors shall be painted, primer plus one coat enamel, color selected by owner.
 - 6. No other painting is required unless specifically called for on the plans.

3.9 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves in foundation walls or footings shall be as detailed on the plans.
- C. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. If sleeves are shown on the plans or details, they shall be grouted in place.
- D. Where pipes and ducts pass through fire walls, plaster or drywall shall be applied around the outside of the sleeve to seal between sleeve and wall.
- E. The internal diameter/dimensions of sleeves shall be 1" to 2" larger than the outside diameter/dimensions of the pipe, duct or insulation. Insulation shall be continuous through sleeves except for ducts with fire dampers. This space is sufficient to allow some movement of the pipes or ducts without cracking the sealant.
- F. The space between the pipes/ducts and the sleeve shall be sealed as follows:

1. Exterior walls above grade: Caulking shall be applied to a minimum 3" total depth. Sealant shall then be applied on both sides of the wall opening to a minimum ½" in depth, finishing flush with the wall.
2. Exterior walls below grade: The space between the pipe and the core drilled hole or sleeve shall be completely filled. Provide mechanical seal and install in accordance with manufacturer's instructions.
3. Openings in floors or roofs: Caulking shall be applied from the upper side to a minimum depth of 3" recessed ½" below the finished floor or roof. This ½" recess shall then be filled with sealant to flush with finished floor or roof.
4. Interior Non-Rated Walls/Partitions:
 - a. Concealed locations: Limit the size of the space between the wall and the outside of the pipe or duct to 1" maximum. The space between the duct or pipe and the wall may be left open.
 - b. Visible Locations: Openings between duct and wall shall be covered with 24 gage galvanized steel sheet metal angles to form an escutcheon to cover the opening. Openings between pipes and wall shall be covered with chrome plated escutcheons.
5. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:
 - a. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.) the pipes shall be sealed per approved methods to meet U.L. Classifications, see the details on the drawings.
 - b. Where ducts pass through fire rated interior assemblies (walls, floors, ceilings, etc.) the ducts shall be connected to sleeves with fire dampers. See section 230900, Air Distribution and details on the drawings.

G. Shop drawings shall be submitted on all fire resistant materials and methods.

3.10 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:
 1. Adjacent to each valve.
 2. At each branch or riser take-off.
 3. Where piping goes through floors, walls or ceilings.
 4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.
- B. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.
- C. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.

- D. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and Plan Number and B) Equipment Service, matching terminology on schedules as closely as possible.
- E. Install tape on top of all underground piping within 12" of grade. Locate markers as follows:
 - 1. Continuously over all underground pipes.
 - 2. Adjacent to each valve and fitting.
 - 3. At each take-off.
 - 4. At each pipe passage to underground.

3.11 LINES AND GRADES

- A. This Contractor shall set all construction stakes required for establishing the lines and grades for underground piping and equipment. He shall assume full responsibility for dimensions and elevations measured from such stakes and reset all stakes displaced or moved while the work is in progress.
- B. This Contractor shall coordinate all elevations and dimensions shown on the drawings with the General Contractor and other subcontractors and report any discrepancies to the Engineer. No work shall be installed until all discrepancies have been resolved.

3.12 EXCAVATION

- A. Excavate, as necessary, for all underground piping as indicated on drawings and/or necessary.
- B. Material to be excavated shall be non-classified and shall include all earth or other materials encountered. The contract price shall cover the removal of all such material to the depth and extent indicated on the drawings and/or herein specified.
- C. Unless otherwise shown, provide separate trenches for each utility. Lay all piping in open trench except when the Engineer gives written permission for tunneling.
- D. Excavation of trenches from surface to top of pipe shall be kept to a minimum but shall be of sufficient width for proper installation of the work. The excavation from bottom of trench to top of pipe shall be not more than twenty (20) inches wider than the outside diameter of the pipe to be laid therein, or where depth of backfill over pipe exceeds ten (10) feet, width of trench at top of pipe shall not exceed 4/3 of nominal diameter of pipe, plus eight inches. For larger pipe, the bottom of trench shall be shaped to conform to the lower half of pipe, and recesses four (4) inches in length shall be cut for pipe bells as required, to give uniform bearing making certain that the pipe is properly supported throughout. Provide ample excavation under and around all pipe joints to permit proper caulking, sealing, welding or thread tightening.
- E. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, and fittings. Remove projecting stones and sharp objects along trench subgrade.

- F. All excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be securely held by bracing or sheeting, which bracing and sheeting shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., to be used by this Contractor shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.
- G. Grading in the area of the excavation shall be such that it shall prevent surface water from flowing into the excavated trench. Under no circumstances lay, pipe or install appurtenances in water. Keep trench free from water until pipe joint materials have hardened. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the contract price.
- H. Where underground pipes cross, the trench of the lower pipe shall be backfilled with sharp sand, well tamped, to provide bed for higher pipe. Pipes which run parallel and at different levels shall be adequately separated to provide firm bedding for the pipes. Sewer, water and gas pipes shall be run in completely separate trenches, and at least three (3) feet apart at center lines, except as approved by the Engineer. Whenever possible, water pipes shall be installed above sewer pipes and gas piping above water and sewer pipes.

3.13 BEDDING AND BACKFILLING

- A. All excavations by this Contractor shall be promptly backfilled.
- B. Trenches for sewers, piping, etc., shall be backfilled for a depth of at least six (6) inches over the top of pipe with sand. Bedding shall be provided in the form of six (6) inches of sand under the pipes. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed beneath haunches of piping and thoroughly compacted to prevent lateral displacement.
- C. Backfill from 0'-6" above the top of the pipe to the surface shall be with clean on-site materials. Large rocks (over 3/4") or other materials shall be removed. Backfill shall be compacted. Compaction shall be at least 90% measured by the Proctor Test (ASTM D 698). Backfill shall be constructed in uniform layers of approximately 6 to 8 inches in loose dimension. Each layer shall be compacted.
- D. Backfill from 0'-6" above the top of the pipe, sewer, conduit, etc., to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of ½".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, recompact, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, dry by discing or other similar methods. If the soils are too dry during construction of the fill, add water in such a way as to permit uniform dispersion of the moisture through the layer to be compacted.

- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 230010

SECTION 230020 – VIBRATION ISOLATION**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Provide vibration isolators and seismic restraints as indicated for each type of equipment and for piping and duct systems. This section applies to:

1. HVAC System

1.2 SCOPE OF WORK

- A. The following items of equipment shall have flexible duct connections installed at the ductwork connection to the equipment:
1. All air handlers, rooftop units, fan coils units, and variable volume terminals.
 2. All exhaust fans, supply fans, relief fans and transfer fans.
 3. Flexible duct connections are specified in Section 230900.
- B. The following items of equipment shall have flexible pipe connectors installed at the piping connection to the items:
1. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
- C. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution to produce reasonably uniform deflections.
- D. All isolators and isolation materials shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
- E. Vibration isolation and seismic control manufacturer shall have the following responsibilities:
1. Determine vibration isolation sizes and locations.
 2. Provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified.
 3. Provide installation instructions and drawings.
- F. All piping and ductwork shall be restrained per the latest revision of the SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

1.3 RELATED DOCUMENTS

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

- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Material and Methods.

1.4 REFERENCES

- A. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Third Edition, 2008.

1.5 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.6 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading (Wherever loads are indicated, they shall apply only to outdoor equipment.)
 - 1. Basic Wind Speed: 250 mph.
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: III.
 - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.7 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, and wind (for outdoor equipment) forces required to select vibration isolators, and wind (for outdoor equipment) restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Indicate association with vibration isolation devices.
 - c. Coordinate restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

1.8 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the products indicated on Drawings or a comparable product by one of the following:
 1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Isolation Technology, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Isolation.
 8. Vibration Mountings & Controls, Inc.
 9. Vibro Acoustics

- B. Specification W: 3/4" thick waffle pad shall be made of standard neoprene and shall consist of 2" square modules separated by a thin web. Load distribution plate shall be used as required. Pads shall be Mason Type Super "W".
- C. Specification B: Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be Mason Type SLF.
- D. Specification E: Vibration hangers shall contain a steel spring with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be Mason Type 30.
- E. Specification RA: Pipe Riser Resilient Support Anchor. All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions. Anchors shall be Mason Type ADA.
- F. Specification RG: Resilient Pipe Guides. Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements. Guides shall be Mason Type VSG.
- G. Specification H: Double-deflection type, elastomeric hangers fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Hangers shall be Mason Type HD.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Interior Applications
 - a. Baked enamel or powder coating for metal components.
 - b. Color coding on springs to indicate capacity range.
 - c. All hardware shall be electro-galvanized or cadmium plated.
 - 2. Exterior Applications

- a. Hot-dip galvanized metal components except as otherwise indicated.
- b. Neoprene coating with color coding on springs to indicate capacity range.
- c. All hardware shall be electro-galvanized or cadmium plated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.

3.3 INSTALLATION OF VIBRATION ISOLATORS

- A. Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install inertia base frames on isolator units as indicated to provide a minimum of 1 inch clearance when frame is filled with concrete and supported equipment has been installed and loaded for operation. Provide 3,000 psi concrete per section 230010 in accordance with manufacturer's instruction to fill base.
- E. Roof curbs and rails shall be set on the roof structure and shall be anchored securely to the supporting structural substrates with bolts or by welding. Anchoring shall be adequate to withstand static and dynamic loads as indicated in the Building Code indicated in Section 230000.
 - 1. Secure equipment to roof curbs and rails with cadmium-plated screws or bolts or other hardware approved by the Engineer unless otherwise indicated on the drawings.
- F. The isolation type scheduled shall be provided for each type of equipment. (Isolators identified as "With Equipment" shall be furnished as an accessory with the equipment and shall be installed by the equipment manufacturer such as for internally isolated air handlers.)

3.4 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Section 230010 for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 percent. Single sided "C" beam clamps shall not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.
- E. Install restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ADJUSTING

- A. Adjust isolators on piping after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

- A. See schedule on plans.

END OF SECTION 230020

SECTION 230100 – INSTALLATION OF MECHANICAL PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, material, services and related items for the HVAC systems shown on the plans and/or specified herein. These systems shall include:
 - 1. Condensate Drains
 - 2. Refrigerant Piping
 - 3. Natural Gas
 - 4. Compressed Air Piping

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230200 - Mechanical Insulation.
- F. Section 230910 - Start-up, Cleaning and Testing.
- G. Section 230930 - Testing and Balancing.
- H. Section 230960 - Temperature Controls.

1.3 REFERENCES

- A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- B. ANSI/ASME 31.9 - Building Services Piping.
- C. MSS SP-58-2009. Manufacturers Standardization Society Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.

1.4 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME Sec 9.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.5 SUBMITTALS

- A. Submit the following in accordance with Section 230000.
 - 1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support. Indicate which piping systems each component will be applied to.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 except as modified herein.
 1. Hangers: Types 5 and 12 shall not be used.
 2. Hangers: Type 3 shall not be used on insulated piping.
 3. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 4. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
 5. Hangers: Type 24 shall be used only on trapeze hanger systems or on fabricated frames.
- B. Components shall have galvanized or cadmium plated coatings where installed for piping and equipment that will not have field-applied finish.
- C. Pipe supports shall be compatible with the pipe being supported to prevent galvanic corrosion. All supports for copper piping shall be copper coated hangers conforming in general to the above specification. Where copper pipes are separated from hangers by pipe insulation, hangers do not need to be copper coated.
- D. Saddles and hangers for insulated piping:
 1. Type 40 shields shall:
 - a. Be used on all insulated pipes less than 12 inches.
 - b. Have a wooden insert for pipes 2 inches and larger, and for smaller pipe when the insulation shows signs of being visibly compressed, or distorted. Insulation jacket shall be sealed at the insert to provide continuity of the vapor barrier.
 - 1) In lieu of the wooden blocks, this Contractor may provide rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket and thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation saddle length shall be 6" for pipes 6" and smaller. Thickness shall be the same as pipe insulation.
 - c. Distribute the loading on the bearing area of the insulation in accordance with the following minimum dimensions covering 180° of arc:

GALVANIZED IRON		
PIPE SIZE (INCHES)	SADDLE LENGTH (INCHES)	GAUGE THICKNESS
1/2 to 4	12	16
- E. The hangers or supports for piping with vapor barriers shall be located outside the insulation and the vapor barrier must be left undisturbed for pipes 10 inches and smaller.

- F. Pipe supports shall be equal to B-Line model numbers hereinafter listed. Equal products by Unistrut or Grinnell are acceptable. (Grinnell numbers are shown in parentheses)

- | | |
|--------------------------------|--|
| 1. Clevis Hanger | Fig. B 3100 or B3104 (260 or 65) |
| 2. Adjustable Swivel Ring | Fig. B 3170 (9) |
| 3. Adjustable Swivel Roller | Fig. B 3110 (181) |
| 4. Adjustable Roller Support | Fig. B 3114 or Fig. B 3122 ((171 OR 177) |
| 5. Riser Clamp (Standard Duty) | Fig. B 3373 (261) |
| 6. Riser Clamp (Heavy Duty) | Fig. (40) |
| 7. Offset Clamp | Fig. B 3148 (103) |
| 8. Wall Bracket (Light Duty) | Fig. B 3068 (194) |
| 9. Wall Bracket (Medium Duty) | Fig. B 3065 (195) |
| 10. Stand with Base | Fig. B 3088 or Fig. B 3088T (62 OR 63) |
| 11. U-Bolts | Fig. B 3188 (137) |
| 12. Structural Attachments: | |
| Beam clamps: | B 3031(92), B 3033(93), B 3034(94), B 3050(133), B 3045(217) and retaining straps for seismic applications |
| Angle Iron Beam Clamp: | B 3046 |
| Bar Joist: | B 3059 |
| Concrete Inserts: | B 2500 (281), B 2505 or 2506(285), or B 3014(282) |
| Drilled Inserts: | Phillips Red-head, wedge anchors |

2.2 PREFABRICATED PIPE STANDS

- A. See Section 230010.

2.3 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. All pipe shall be run parallel to or at right angles to walls, beams or columns. Pipe shall be run as direct as possible, avoiding unnecessary offsets, and maintaining maximum headroom. Shortcut diagonal methods will not be allowed.
- B. Piping drawings are to be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be furnished and installed. Provide reducers/increasers at connections to equipment as required to match the equipment. Pipe and fittings shall be installed so that all pipe and/or insulation completely clears all nearby structures and piping.

- C. All piping shall be supported from the building structures by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitch of lines, to prevent vibration and excessive deflections, and to secure piping in place.
- D. Piping shall be arranged to allow for expansion and contraction. Provide expansion loops, guides and anchors where indicated on the drawings.
- E. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line except branch take-offs shall be made with swing connections where required to avoid stress at these points. Tees shall not be installed in a bullhead arrangement.
- F. At swing connections, offsets, expansion loops, etc., pipes shall be cold sprung into place before welding to compensate for fifty percent (50%) of the expansion.
- G. Pipes shall not be hung from other piping or from equipment of other trades. Hanger rods and piping shall not pierce ductwork.
- H. Pipe supports shall be structurally capable of carrying the pipe or pipes supported by them and shall be capable of vertical adjustment after installation of piping.
- I. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping shall be installed and supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed.
- J. Install unions in pipes 2-1/2 inch and smaller at final connections to each piece of equipment and at valves, strainers, traps, etc., and elsewhere as indicated. Unions are not required on flanged devices. Install flanges on valves, apparatus, and equipment having 3 inch and larger connections.
- K. Dissimilar metals in the piping system shall be separated with dielectric unions or insulating flange sets.
- L. Provide plugged tees at all low points, except where drain valves are called for to allow for system drainage. All pipe lines shall be pitched to equipment traps and/or outlets. All horizontal mains shall be graded to have a pitch of at least 1" in 40'-0" in the direction of flow unless otherwise noted. Eccentric couplings, pitched fittings, etc., shall be installed where necessary to eliminate pockets.
- M. Factory fabricated fittings, similar to Bonney Forge Weldolet, Thredolet, Socklolet, or Elbolet may be used for branch connections to mains where branch size is less than main's size.
- N. Welding shall be performed by individuals who are currently qualified under procedures certified as acceptable by the National Certified Pipe Welding Bureau. Individuals must be prepared to provide current qualification certificates upon request. All work shall be done in accordance with the latest revised edition of the ASME Code for Pressure Piping requirements.
- O. Lines subject to rapid changes in flow rate shall be anchored to prevent excessive movement or vibration.

- P. Drain lines shall be terminated over floor drains to direct the flow vertically into the floor drain. Provide elbows where required. Cut openings in the floor drain strainer where needed to prevent splash-out. Provide clean outs at changes in direction of more than 45 degrees and at maximum 75 feet spacing along the line.

3.2 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 - 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
 - 2. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.
 - 3. Heat joints using oxy-acetylene torch to proper and uniform temperature.
- C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Align threads at point of assembly.
 - 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 - 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
 - a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Welded Joints: Comply with the requirement in ASME Code B31.9-"Building Services Piping."
- E. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- F. Grooved Joints: Assemble joints in accordance with fitting manufacturers written instructions.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments, complete with necessary inserts, bolts, rods, nuts, washers, and other accessories, to support piping from building structure; comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-58.
- B. Install building attachments within concrete or to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed;

fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts. Where inserts are omitted, drill through concrete slab and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab in locations where nut, etc. will interfere with other work or be a tripping hazard and above slab in other locations.

- C. Hangers and supports shall be provided as required to eliminate vibration and excessive deflection, but in no case over the following centers, unless specifically indicated otherwise on the drawing. Rod sizes for individual pipe lines shall not be less than the following schedule:

(STL = Steel , CU = Copper)

PIPE SIZE (INCHES)	MAXIMUM HANGER SPACING (FEET)	MINIMUM ROD SIZE (INCHES)	MAXIMUM HANGER SPACING (FEET)	MINIMUM ROD SIZE (INCHES)
	STL	STL	CU	CU/PVC
1/2	7	3/8	5	3/8
3/4	7	3/8	5	3/8
1	7	3/8	6	3/8
1-1/4	7	3/8	7	3/8
1-1/2	9	3/8	8	3/8
2	10	3/8	8	3/8
2-1/2	11	1/2	9	1/2
3	12	1/2	10	1/2
3-1/2	13	1/2	11	1/2

*Maximum spacing for insulated pipe shall be 20 feet.

1. An additional hanger shall be installed at every change in direction of piping.
- D. When trapeze type hangers are used to support two or more pipes, rods shall be used for vertical hanger members and angles, channels, Unistrut or tee sections for horizontal hanger members. The material used shall be sized to support the load without excessive deflection. Spacing of trapeze hangers shall be based on the smallest pipe supported on the trapeze hanger. Rod sizes and spacing for trapeze hangers shall be based on supported weight and load carrying capacity of attachment device. Size trapeze bar for allowable loads indicated in SMACNA HVAC Duct Construction Manual (2005), Table 4-3, or as otherwise approved by the Engineer.
- E. Hanger rods shall have double nuts and lockwashers at all connections.
- F. Piping at walls shall be supported with wall brackets; vertical pipes shall be supported with riser clamps.
- G. Contractor shall verify loading on hangers, hanger rods and structural attachments. Loading on the assembly shall not exceed 75% of the manufacturer's rating for any component of the assembly. If loading does exceed the 75%, then hanger spacing shall be reduced.

- H. Condensate piping shall be mounted on roller supports. Where required for achieving pitch, etc., roller supports shall be vertically adjustable.
- I. Piping shall not be supported from joist bridging or a roof metal deck.
- J. Horizontal pipe supports shall be:
 - 1. Spaced as specified in MSS SP-69.
 - 2. Installed $\leq 1'$ from the pipe fitting joint, at each change in pipe direction.
 - 3. $\leq 5'$ apart at valves.
 - 4. Pipe hanger loads ≥ 50 lbs, suspended from steel joists, shall have the hanger loads suspended from panel points.
 - 5. Maximum of $4'$ on center for PVC piping. *Note: Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements.*
- K. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.
- L. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.
- M. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger with medium 60 degrees F or greater, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.
- N. High Temperature Guides with Cradles: Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.
- 3.4 Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6-inch and larger shall be sheet metal. See additional requirements in Section 230010.
- 3.5 Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Section 230010 for sealants and materials.
- 3.6 Provide thermometers, thermometer sockets, and thermal wells where indicated on the drawings or in the specifications. Install in tees or in extra heavy nipples welded to the pipe or as indicated on the drawings. Install thermal wells for temperature control system temperature sensors (furnished under Section 230960 - Temperature Control Systems) and where indicated on the drawings. Coordinate the location of temperature sensor wells with the temperature control contractor and the Engineer.

- 3.7 Install control valves and pressure sensors in accordance with the manufacturer's instructions where indicated on the drawings or in the specifications. Install taps and shut off valves for pressure sensors for temperature control system sensors (furnished under Section 230960 - Temperature Controls) and where indicated on the drawings.
- 3.8 Provide pressure gauges and test plugs where indicated on the drawings or in the specifications.
- 3.9 Dielectric unions shall be provided at the following locations:
 - A. At the connection of copper and steel piping.
 - B. At the connection of steel piping to copper coils.

END OF SECTION 230100

SECTION 230140 – NATURAL GAS PIPING**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Furnish all labor, material, services and related items necessary to complete the natural gas piping work indicated on the drawings and/or specified herein. Work to be performed shall include, but not be limited to, the following items:
 - 1. Installation of all natural gas piping including connections to all equipment.
 - 2. Connections to the utilities gas meter including all utility service requirements.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230100 - Installation of Mechanical Piping.
- F. Section 230910 - Start-up, Cleaning and Testing.

1.3 SUBMITTALS

- A. Submit product data for each gas piping, specialty and valve under provisions of Section 230000. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.
- B. Shop drawings detailing dimensions, required clearances, for connection to gas meter.
- C. Maintenance data for gas specialties and valves, for inclusion in operating and maintenance manual specified in Section 230000.
- D. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

1.4 QUALITY ASSURANCE

- A. Codes and Standards
 - 1. Applicable local, state and national codes.
 - 2. NFPA Pamphlet 54A and 54
 - 3. Rules and regulations of the local utility company.
 - 4. Service and Line Natural Gas Pressure Regulators ANSI Z21.80.
 - 5. Appliance Natural Gas Pressure Regulators ANSI Z21.18.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe - Carbon steel pipe ASTM-A53 continuous electric weld or seamless, Schedule 40.
- B. Threaded Fittings - Malleable iron, threaded, 150 lb., ASA B16.3, ASA B2.1, material ASTM A-47, Grade 32510.
- C. Weld Fittings - Seamless carbon steel Grade B standard weight butt weld fittings, ASA B16.9, material ASTM A-234.
- D. Unions - Malleable iron, 150 lb., threads ASA B2.1, material ASTM A-47 Grade 32510, ASA B16.3, ground joint, bronze-to-bronze seats.
- E. Flanges - Forged carbon steel bored to match Schedule 40 pipe, 150 lb., ASA B16.5, raised face, slip-on, materials ASTM A-181, Grade 1.

2.2 VALVES AND SPECIALTIES

- A. Gas cocks shall be "Lubroseal" by Mueller Company or approved equal. Use threaded cocks in threaded piping and flanged cocks in welded pipe. Gas cocks shall be bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 125 psig minimum pressure rating. Include feature for locking.
- B. Insulating unions shall be Eclipse Wedge Seal or approved equal. Insulation flanges shall have Type FNDW gasket set as manufactured by F. H. Maloney Company or approved equal. Install unions or flanges where shown on drawings and whether shown or not, at entrance to building.
- C. Electrically Operated Gas Valves: UL 429, bronze, aluminum, or cast-iron body solenoid valve; 120 Vac, 60 Hz, Class B, continuous-duty molded coil. Include NEMA ISC 6, Type 4, coil enclosure and electrically opened and closed dual coils. Valve position shall normally be closed. If an electrically operated gas valve is required, it shall be U.L. Listed for use with the kitchen fire suppression system which it is connected to and shall operate by using a micro switch and a U.L. listed manual reset relay.

2.3 FLEXIBLE GAS CONNECTORS

- A. Flexible gas connectors shall comply with the following:
 - 1. Bronze metal braided, bellows type, screwed or flanged, unbraided working pressure rating of 45 psig at a maximum service temperature of up to 175°F. End fittings factory welded to hose.
 - 2. Suitable for natural gas.
 - 3. Connector length shall be no greater than 24".
 - 4. Manufactured by Flexonics, Anaconda, or Metalflex.

2.4 PRESSURE GAUGES

- A. Manufacturer: Subject to compliance with requirements, provide piping system products from one of the following:

1. Marsh
 2. Weiss
 3. U.S. Gauge
 4. Weksler
 5. Trerice
- B. Gauges shall be equal to Trerice #800B.
- C. Gauges shall include the following:
1. 1-1/2" diameter
 2. Drawn steel, black case
 3. Styrene acrylonitrile window
 4. ABS plastic white dial face with black graduations
 5. Bronze tube, Bourdon Type
 6. Brass movement
 7. 1/4" NPT bottom connections with brass tee handle cock.
- D. Submit shop drawings on gauges.
- E. Graduation of pressure gauges shall be:
- | | RANGE | DIVISIONS | FIG. INTERVAL |
|-----|------------|-----------|---------------|
| Gas | 0 – 15 psi | 0.5 psi | 3 psi |
- F. Gauge cocks shall be brass, equal to Trerice No. 865 or 880, and shall be provided at all gauges.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- A. See Section 230100 for general piping installation.
- B. Comply with ANSI Z223.1, "Prevention of Accidental Ignition".
- C. Contractor shall extend gas piping to all gas fired equipment. A gas cock shall be provided at each item.
- D. Dirt legs shall be provided at the connection to all gas fired equipment.
- E. Thread sealing compound compatible with service shall be used on all threaded joints.
- F. Gas piping above ground, not in concealed spaces, 3" and smaller shall be either threaded or welded.
- G. Gas piping 3-1/2" and over shall be welded.
- H. All gas piping in concealed spaces shall have joints welded, and pipe shall be run in sealed EMT conduit with both ends vented to the outside of the building. The following gas piping shall be considered concealed:
 1. Piping located in walls.

2. Piping located in any non-ventilated space.
 - I. Contractor shall extend all gas train vents to and terminate outside the building. Vents shall terminate with screened vent elbow turned down. Each vent connection shall be individually extended to outdoors.
 - J. Flexible connectors shall be used only where specifically called for on the plans. Do not install flexible connectors where prohibited by local code.
- 3.2 ADJUSTING
 - A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 230140

SECTION 230150 - REFRIGERANT PIPING**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Furnish all labor, material, services and related items necessary for the refrigerant piping systems shown on the plans and as specified herein. These systems shall include:
 - 1. Refrigerant Piping
 - 2. Refrigerant
 - 3. Refrigerant Piping Specialties
- B. Coordinate refrigerant pipe size with refrigerant component manufacturer.

1.2 RELATED DOCUMENTS

- A. All applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.

1.3 REFERENCES

- A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 34 - Number Designation of Refrigerants.
- C. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.
- D. ANSI/ASME SEC 9 - Boilers and Pressure Vessels Code, Welding and Brazing Qualifications.
- E. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- F. ANSI/ASME B31.5 - Refrigeration Piping.
- G. ANSI/ASME B31.9 - Building Services Piping.
- H. AWS - Brazing.
- I. ANSI/ASTM B88 - Seamless Copper Water Tube.
- J. ANSI/AWS A5.8 - Brazing Filler Metal.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
- C. Welder's Certification: In accordance with ANSI/ASME SEC 9.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 230000 - Mechanical General Conditions.

- B. Submit shop drawings indicating isometric layout of system, including equipment, critical dimensions, and sizes.
- C. Submit product data indicating general assembly of specialties, including manufacturer's catalog information.
- D. Submit manufacturer's installation instructions under provisions of Section 230000.
- E. Submit welder's certification of compliance with ANSI/ASME SEC 9.
- F. Submit test reports indicating results of leak test, acid test.
- G. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All refrigerant and refrigerant oil shall be delivered to the site in factory sealed containers.
- B. Deliver and store piping and specialties in shipping containers with labeling in place.
- C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPE AND FITTINGS

- A. Piping: Copper Tubing, ASTM B280, Type ACR, hard drawn, factory cleaned, dehydrated and pre-charged with nitrogen. "ACR" as manufactured by Mueller Brass Company or equal.
- B. Fittings: ANSI/ASME B16.22 wrought copper or forged brass.
- C. Brazing Filler Metals: AWS A5.8/A5.8M.
- D. Joints: All joints shall be brazed with a constant bleed of nitrogen to prevent formation of oxide or scale.

2.2 REFRIGERANT LINE KITS

- A. Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with refrigerant, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.
 - 1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 3/8 inch thick.

2.3 REFRIGERANT SPECIALTIES

- A. Manufacturers: One manufacturer has been listed with the various specialties to establish desired type. Equal product of the following manufacturers are acceptable.
 - 1. Expansion valves, solenoid valves, filter driers, moisture and liquid indicators.

- a. Alco Valve Company
 - b. Sporlan Company
 - c. Mueller Brass
2. Valves, strainers, check valves, relief valves.
 - a. Mueller Brass
 - b. Henry Valve Company
 - c. Superior Valve Company
 - d. Vilter
 - e. York
3. Receivers
 - a. Standard Refrigeration
 - b. Vilter
 - c. E. L. Nickel
4. Flexible Connectors
 - a. Resistoflex
 - b. Flexonics
 - c. Keflex
- B. Shut off Valves: Packed, back seating type with seal cap and arranged for straight through flow. Valves shall be full line size with renewable seats, brass body. Capable of being re-packed under line pressure. Rated for maximum working pressure of 500 psi and maximum temperature of 275 degrees F. Mueller Brass "Globemaster".
- C. Filter Driers:
 1. Sealed type: "Catch-All" by Sporlan Valve Company. UL listed. Size of drier as recommended by manufacturer with a maximum drop of 1 PSI. Rated for maximum working pressure of 350 psi.
 2. Replaceable Cartridge Angle Type: ANSI/ARI 710, UL listed, brass shell and bronze cap, perforated brass shell and molded desiccant filter core; size of drier as recommended by manufacturer with a maximum drop of 1 PSI. Rated for maximum working pressure of 350 psi.
- D. Sight Glasses: Liquid and moisture indicating type, "Eye-Spy" by Alco Valve. Full line size. Where line size is larger than standard sight glass size, install in bypass line using manufacturer's bypass kit in accordance with manufacturer's recommendations.
- E. Solenoid Valves: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, with solder ends; for maximum working pressure of 500 psi. Stem shall permit manual operation in case of coil failure. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with integral junction box; ANSI/UL 429.

- F. Expansion Valves: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube, remote sensing bulb and remote bulb well.
 - 1. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.
- G. Strainers: Brass shell, cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.
- H. Check Valves:
 - 1. Globe Type: Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
 - 2. Straight Thru Type: Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.
- I. Pressure Relief Valves: Straight Thru or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 235 psi setting; selected to ANSI/ASHRAE 15.
- J. Receivers:
 - 1. Internal Diameter 6 inch and Smaller: ANSI/ARI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
 - 2. Internal Diameter Over 6 inch: ANSI/ARI 495, welded steel, tested and stamped in accordance with Section 8D of the ANSI/ASME Boiler and Pressure Vessels Code; 400 psi with tappings for inlet, outlet and pressure relief valve.
- K. Flexible Connectors: Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 500 psi.
- L. Refrigerant: R-32.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Install piping as shown on the plans with no additional bends or offsets. If a conflict occurs between refrigerant piping and other building components, notify the Engineer for resolution before proceeding.
- B. Piping may be pre-insulated line sets if approved by the manufacturer of the condenser, condensing unit, evaporator, and other refrigeration components.

- C. If refrigerant pipe sizes are not shown on the plans, sizing and routing shall be in accordance with the refrigerant component manufacturer's recommendations. If refrigerant pipe sizes are shown on the plans, verify refrigerant pipe sizing and routing with the manufacturer of the condenser, condensing unit, evaporator, and other components PRIOR TO THE INSTALLATION of any piping and report to the Engineer if the sizes or routing are in conflict with the manufacturer's recommendations. Install piping of the sizes recommended by the manufacturer at no additional cost to the Owner or Engineer.
- D. All components of the refrigerant system shall be designed for the type of application, refrigerant, and the system pressures encountered. All components, methods of installation, testing procedures, etc., shall be in accordance with all applicable codes.
- E. Hanging and supporting of refrigerant piping shall be as specified in Section 230100, Installation of Mechanical Piping.
- F. Pitch piping in the direction of flow with no pockets or traps other than those indicated on the plans. Oil traps that are indicated shall be made as small as possible and still retain the intended function.
 - 1. Refrigerant piping in VRF systems shall meet all manufacturer requirements.
- G. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

3.2 INSTALLATION OF REFRIGERANT SPECIALITIES

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Filter Driers
 - 1. Provide permanent filter-driers in low temperature systems, systems utilizing hermetic compressors, and where indicated.
 - 2. Provide replaceable cartridge filter-driers vertically in liquid line adjacent to receivers.
 - 3. Provide replaceable cartridge filter-driers, with three-valve bypass assembly.
 - 4. Provide filter-driers for each solenoid valve.
- C. Sight Glasses
 - 1. Provide sight glasses ahead of all solenoid valves and where indicated.
 - 2. Provide line size sight glasses in main liquid line leaving condenser, or if receiver is provided, in liquid line leaving receiver.
- D. Solenoid Valves
 - 1. Provide solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down, and where indicated.
 - 2. Provide electrical connection to solenoid valves.

E. Expansion Valves

1. Provide expansion valves in liquid line at each connection to DX coils (distributor) and where indicated.
2. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
3. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

F. Strainers

1. Provide line size strainer upstream of each automatic valve. Where multiple expansion valves with integral strainers are used install single main liquid line strainer.

G. Shut Off Valves

1. Provide shut-off valves on each side of strainer and where indicated.
2. Provide refrigerant charging (packed angle) valve connections in liquid line between receiver shut-off valve and expansion valve.

H. Check Valves: Install where indicated.

I. Relief Valves: Install where required by code and where indicated.

J. Receivers: Install where indicated.

K. Flexible Connectors

1. Utilize flexible connectors at or near compressors where piping configuration does not absorb vibration and where indicated.
2. Install flexible connectors at right angles to axial movement of compressor.

3.3 TESTING

A. Testing for pre-charged refrigerant line kits is not required.

B. When installation of field installed refrigerant piping and fittings is complete, disconnect and cap all lines to gauges, controllers, etc., which might be damaged by a pressure test. Open all service valves in systems and charge system with refrigerant in accordance with the manufacturer's written requirement. Add sufficient dry nitrogen to raise system to pressures on suction, discharge and liquid sides of system as indicated below (or higher if required by local code). Check all joints and connections for leaks with a halide torch or electronic leak detector. If leaks are found, all leaks shall be repaired and system retested.

C. After system is proven to be completely free of leaks, the entire system shall be dehydrated by evacuating with vacuum pump. System compressors shall not be used as a vacuum pump. Pull system down to 100 microns and hold for 8 hours. Break vacuum with dry nitrogen. Repeat procedure three times with vacuum being broken the last time with refrigerant. Charge system with refrigerant and check the equipment in accordance with manufacturer's recommendations.

- D. DO NOT DISCHARGE ANY REFRIGERANT TO THE ATMOSPHERE.
- E. Test Pressure Requirements
 - 1. Line Test Pressure for Refrigerant R-32:
 - a. Suction Lines for Air-Conditioning Applications: 300 psig.
 - b. Suction Lines for Heat-Pump Applications: 535 psig.
 - c. Hot-Gas and Liquid Lines: 535 psig.
- 3.4 Troubleshoot all components of the refrigerant system, both new and existing, when the refrigeration system is started up until the system is operating satisfactorily.

END OF SECTION 230150

SECTION 230170 - COMPRESSED AIR PIPING**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Furnish all labor, material, services and related items necessary to furnish and install the compressed air piping shown on the plans and/or specified herein.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230100 - Installation of Mechanical Piping.
- F. Section 230910 - Start-up, Cleaning and Testing.

1.3 REFERENCES

- A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings.
- C. ANSI/ASME B16.39 - Malleable Iron Unions.
- D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- E. ASTM A197 - Malleable Iron Threaded Fittings Class 150 and 300.
- F. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- G. ASTM B88 - Seamless Copper Water Tube.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Product Data: Submit manufacturer's technical product data for pipe materials, pipe fittings, valves, specialties and accessories, indicating dimensions, capacities, performance characteristics, and including installation instructions and start-up instructions.
- C. Indicate seismic restraint locations including both lateral and transverse bracing on each shop drawings and described on product data. Indicate each restraint type as described on product data.
- D. Shop Drawings: Submit shop drawings for each system, containing the following information:
 - 1. Schematic flow diagram of system showing valves and control devices.
 - 2. Label each control device with setting or adjustable range of control.

- E. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 230000.

PART 2 - PRODUCTS

2.1 COMPRESSED PIPING AIR MATERIALS

- A. The entire compressed air system, including all pipe, fittings, valves, accessories and equipment shall be suitable for a continuous operating pressure of 150 psig.
- B. Schedule of Pipe Materials:

ITEM

Pipe	Type (1)
Fittings	Type (1) (150 lbs.)
Unions	Type (1) (150 lbs.)
Stop Valves	Type (1) or (6)
Check Valves	Type (1) or (6)
Flexible Connector	Type (1)
Joints	Type (1) or (2)

This Contractor may at his option use the following materials in lieu of those listed above:

ITEM

Pipe	Type (7)
Fittings	Type (7)
Unions	Bronze
Stop Valves	Type (6)
Check Valves	Type (1) or (6)
Flexible Connectors	Type (1)
Joints	Type (3)

- C. Furnish and install compressed air pressure regulators and combination filter and air pressure regulators where called for on the plans. Regulators and filter regulators shall be Parker-Hannifin, Rego, or equal, and shall include:
1. Regulator shall have manual adjustment of downstream pressure. Regulators shall be capable of maintaining downstream pressure within ± 3 psi of set pressure.
 2. Pressure gauge on downstream side.
 3. Built-in pressure relief on downstream side to relieve excessive pressure.
 4. Transparent, shatter-proof bowl with manual moisture drain valve.
 5. Filter shall provide 95% removal of water and solids by centrifugal and by filtration. Filter shall remove particles of the 40 micron size.
- D. Pipe
1. Type (1) - Galvanized steel pipe, ASTM-A53 Type F, continuous weld, or ASTM-A53 Type E or S, grade B, ERW or seamless.

- a. 1/2" - 1-1/2" Schedule 80
- b. 2"-4" Schedule 40

- 2. Type (7) - ASTM B 88, Type L hard drawn copper.

E. Alternate Piping

- 1. Chem-Aire or equivalent ABS (acrylonitrile butadiene styrene) plastic piping system designed for compressed air to be shatter-resistant, have outstanding strength, ductility, and impact resistant, shall conform to ASTM D-3965.
- 2. Design stress minimum of 1250 psi @ 73°F incorporating a 2 to 1 safety factor allowing a service life exceeding 50 years under continuous pressure conditions.
- 3. Pipe shall be designed to iron pipe outside diameters with heavy-duty wall thickness conforming to a SDR (standard dimension ratio of 9.0 for 1/2" thru 2" and 10.0 for 3" thru 4").
- 4. Fittings shall be designed to schedule 80 dimensions with industrial heavy duty hub style design.
- 5. Plastic connections shall have standard tapered socket joints designed for solvent cement interference fit, with sched. 80 socket lengths for maximum strength.
- 6. Pipe and fittings pressure rated for continuous use at 185 psi @ 100°F.
- 7. Valves, unions, and flanges pressure rated for continuous use at 150 psi @ 100°F.
- 8. Maximum service temperature shall be 120°F.
- 9. All piping shall be bright green, clearly marked with manufacturer and nominal size.
- 10. Chem-Aire Customer Service Center
5250 West 76th Street
Indianapolis, Indiana 46268
800 343-5455
fax: 800 541-3841

F. Fittings

- 1. Type (1) - Malleable iron, screwed 150 lb. Standards: ANSI B16.3, threads ASA B2.1; material ASTM A-197.
- 2. Type (7) - Wrought or case bronze solder type fittings. T-drill fittings not acceptable.

G. Unions and Flanges

- 1. Type (1) - Galvanized malleable iron unions, 150 lbs. Standards: Threads ANSI B2.1; Material ASTM A-197, ASA B16.39, Ground joint bronze-to-iron.
- 2. Type (2) - Galvanized forged carbon steel flange, ASTM A105, Class 150, ANSI-B16.5, slip on or weld neck (SCH 40), flat face.
- 3. Type (7) - All bronze or brass, suitable for 150 psi working pressure.

H. Joint Material or Gaskets

- 1. Type (1) - Thread sealing compound compatible with air.
- 2. Type (2) - Full faced, ANSI B16.21, Class 150, 1/8" thick black neoprene, Garlock 8639, Manville or equal.
- 3. Type (3) - 95/5 solder.

I. Flange Bolts and Nuts

1. Type (1) - Hot dip galvanized carbon steel heavy hex head bolts ASTM A-307 Grade B, with heavy hex head nuts for Class 150 joint.

J. Valves

1. Each valve shall be shell and seat tested by the manufacturer and shall carry a permanently affixed indication that tests have been successfully completed.
2. All valves of the same type shall be of the same manufacture.
3. Valves shall not contain asbestos.
4. Operators: Provide the following special operator features:
 - a. Handwheels, fastened to valve stem, for valves other than quarter turn.
 - b. Lever handles, on quarter-turn valves 6-inch and smaller.
 - c. Gear drive operators, on quarter-turn valves 8-inch and larger.
 - d. Malleable iron chain wheel operator and chain for valves located more than 7 feet above the floor except for valves located above ceilings; provide chains for operation at 5 feet above floor.
5. Shop drawings shall be submitted on all valves. Each submittal shall be clearly marked for the service intended.
6. Model numbers used for each type of valve shall establish the desired type, quality and materials of construction. Products equal to the valve specified and meeting these specifications, by the following manufacturers are equally acceptable:
 - a. Nibco
 - b. Watts
 - c. Crane
 - d. Lunkenheimer
 - e. Stockham
 - f. James Bury
 - g. Gemini
 - h. Contramatics
 - i. Jenkins
 - j. Centerline
 - k. Demco
 - l. DeZurik
 - m. Keystone

K. Stop Valves

1. Type (1) - Nibco T-585-70NS, 2 pc. bronze ball valve, teflon seats and seals, full port, chrome plated brass ball and blow out proof bronze stem, threaded ends, comply with MSS-SP-110. 150 psi steam, 600 psi WOG.
2. Type (6) - Nibco LD-2100, iron body butterfly valve, lug type, aluminum-bronze disc, stainless steel stem and disc screws, Buna N stem seals, Nitrile replaceable seat, infinite position lever handle with memory stop, comply with MSS-SP-67, suitable for dead end

service at full pressure rating of valve. Valves above 6" NPS shall have a gear operator. 150 psi WP, 50 to 275°F.

L. Check Valves

1. Type (1) - Nibco T-413-Y, bronze swing check, Class 125, ASTM B-62 body, TFE seat, threaded ends, comply with MSS-SP-80, 125 psi steam, 250 psi WOG.
2. Type (6) - Nibco W910-W or W920-W, wafer type, ASTM A126 Class B or A48 iron body, bronze disc plates, rubber seat, comply with MSS-SP-71, non-asbestos gaskets, stainless steel hinge pins, stop pins and spring, suitable for continuous duty at 125 psi and 250°F.

M. Flexible Pipe Connectors

1. Type (1) - Bronze metal braided, bellows type, screwed or flanged, 150 psi working pressure at the maximum service temperature (up to 250°F). Length shall allow for 1/2" misalignment.
2. Flexonics, Anoconda, Metaflex, or approved equal.

N. Dielectric Fittings

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 175 psig.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.

b. Description:

- 1) Non-conducting materials for field assembly of companion flanges.
- 2) Pressure Rating: 150 psig.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

O. Specialties

1. Safety Valves:

- a. ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed.
- b. Constructed of bronze body with poppet-type safety valve for compressed-air service. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- c. Manufacturers: Subject to compliance with requirements, provide products of one of the following: McDaniel, Cash-Acme, Fisher, or approved equal.

2. Air-Main Pressure Regulators:

- a. Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
- b. Manufacturers: Subject to compliance with requirements, provided product by one of the following: Numatics, Watson McDaniel, Cash-Acme, Fisher, or approved equal.
- c. Type: Pilot operated.

3. Air-Line Pressure Regulators:

- a. Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- b. Manufacturers: Subject to compliance with requirements, provided products by one of the following: Numatics, Watson McDaniel, Cash-Acme, Fisher, or approved equal.

4. Air-Line Pressure Regulators:

- a. Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- b. Manufacturers: Subject to compliance with requirements, provided products by one of the following: Numatics, Watson McDaniel, Cash-Acme, Fisher, or approved equal.

5. Automatic Drain Valves:

- a. Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Van Air Products, Chicago Pneumatics, Ingersoll Rand, Parker, General Air Products, Wilkerson
6. Coalescing Filters:
- a. Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.
 - b. Manufacturers: Subject to compliance with requirements, provided products by one of the following: Wilkerson, Parker, Ingersol Rand, Aro, or approved equal.
7. Mechanical Filters:
- a. Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock.
 - b. Include mounting bracket if wall mounting is indicated.
 - c. Manufacturers: Subject to compliance with requirements, provided products by one of the following: Numatics, Wilkerson, Groz, or approved equal.
8. Air-Line Lubricators:
- a. With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.
 - b. Provide with automatic feed device for supplying oil to lubricator.
 - c. Manufacturers: Subject to compliance with requirements, provided products by one of the following: Numatics, Wilkerson, Groz, or approved equal.
- P. Quick Couplings
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroquip Corporation; Eaton Corp.
 - b. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
 - c. Schrader-Bridgeport; Amflo Div.Schrader-Bridgeport/Standard Thomson.
 - d. Snap-Tite, Inc.; Quick Disconnect & Valve Division.
 - e. Tuthill Corporation; Hansen Coupling Div.
 - 2. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
 - 3. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - 4. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

5. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.
6. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
7. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
8. Plug End: With barbed outlet for attaching hose.

Q. Hose Assemblies

1. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
2. Hose: Reinforced single- or double-wire-braid, CR-covered hose for compressed-air service.
3. Hose Clamps: Stainless-steel clamps or bands.
4. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
5. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 INSTALLATION OF COMPRESSED AIR PIPING

- A. Installation of piping shall be in compliance with Section 230100, Installation of Mechanical Piping.
- B. Provide manual moisture blowdown valves at low points in piping system and at 200 foot intervals along horizontal mains to allow blowdown of collected moisture. Blowdown valve shall consist of a 1/2" Type (1) valve with threaded plug in open end on a moisture leg. On horizontal runs, moisture leg shall be installed downstream of eccentric increaser and upstream of eccentric reducer.

3.2 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.3 SPECIALTY INSTALLATION

- A. Install all specialty components in accordance with their manufacturer's installation instructions and details on the plans.
- B. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- C. Install air-main pressure regulators in compressed-air piping at or near air compressors.

- D. Install air-line pressure regulators in branch piping to equipment and tools.
- E. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
- F. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.
- G. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated.
- H. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.
- I. Install quick couplings at piping terminals for hose connections.
- J. Install hose assemblies at hose connections where indicated on the plans.

END OF SECTION 230170

SECTION 230200 – MECHANICAL INSULATION**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the thermal insulation work indicated on the drawings and/or specified herein.
 - 1. Mechanical Piping.
 - 2. Mechanical Equipment.
 - 3. Ductwork.

1.2 WORK EXCLUDED

- A. Work not included in this Section that is specified in other Sections of these specifications:
 - 1. Plumbing systems piping insulation - Section 220400.
 - 2. Duct liner - Section 230900.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230100 - Installation of Mechanical Piping.
- D. Section 220400 - Plumbing Systems (plumbing piping insulation).
- E. Section 230900 - Air Distribution.

1.4 QUALITY ASSURANCE

- A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 method.
- B. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Submit product data under provisions of Section 230000. Indicate application for each product.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Store insulation in a clean, dry place and protect against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.7 REFERENCES

- A. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.
- C. NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- D. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
- E. ASTM C 547 Standard Specification for Mineral Fiber Pipe Insulation.
- F. ASTM C 553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- G. ASTM C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- H. ASTM C 1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- I. ASTM C 1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- J. ASTM C 1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
- K. ASTM C 1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation.

PART 2 - PRODUCTS

- 2.1 The piping insulation material for each Type is specified to establish the desired quality and performance. Equal products, complying with the requirements of these specifications, by the following manufacturers are acceptable:
 - A. Owens-Corning

- B. Certain-Teed
 - C. Manson Insulation
 - D. Knauf Insulation
 - E. Johns Manville
 - F. Rubatex
 - G. Armacell
- 2.2 Type (1) - Fiberglass Preformed Pipe Insulation: Glass fibers bonded with thermosetting resin, complying with ASTM C547, Type I. Fiberglass with factory-applied, ASJ+ SSL+ all service polymer jacket with self- sealing lap down joints and butt strips, complying with ASTM C1136. Vapor barrier in jacket, <.01 perm rating. Thermal conductivity shall be 0.23 BTU/HR/SF°F/IN @ 75°F mean temperature, 0.26 BTU/HR/SF°F/IN @ 100°F mean temperature, 0.3 @ 200°F, 0.35 @ 300°F or less. Owens-Corning Fiberglass, Fiberglass 25 with ASJ Max all service jacket with a polymer film exterior surface, seal down lap joints, vapor barrier in jacket or equal by others listed above. PVC jacket over fittings. Aluminum jacket over straight sections of piping located outdoors.
- 2.3 Type (2) - Flexible Elastomeric Insulation: Armatuff Plus II (Flame/Smoke Rating less than 25/50 thru 1" thickness per ASTM E-84) Armaflex foamed plastic flexible sheeting laminated with a white thermoplastic rubber membrane (TPR). TPR membrane shall be UV resistant with a 25 year warranty. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature.
- 2.4 Type (3) - Flexible Elastomeric Insulation: Armacell AP/Unslit (Flame/Smoke Rating less than 25/50 thru 1" thickness per ASTM E-84) Armaflex foamed plastic flexible tubing insulation Unslit. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature. See Execution for allowable locations of Lap Seal.
- A. Provide Armafix insulated pipe hangers at all pipe hangers for continuous vapor barrier.
- 2.5 Type (4) - Fiberglass Rigid Board Insulation: Owens Corning type 703-FRK-25, 3 pound per cubic foot density, rigid insulation. Temperature range -60°F to 450°F. "K" value (BTU/HR/FT^2/IN/F) of 0.23 or less at 75 degrees F and 0.30 at 100 degrees F. Factory applied FSK vapor barrier. Odor free and resistant to growth of bacteria or fungus.
- 2.6 Type (5) - Fiberglass Rigid Board Insulation: Owens Corning type 705-FRK-25, 6 pound per cubic foot density, rigid insulation. Temperature range -60°F to 450°F. "K" value (BTU/HR/FT^2/IN/F) of 0.23 or less at 75 degrees F and 0.30 at 100 degrees F. Factory applied FSK vapor barrier. Odor free and resistant to growth of bacteria or fungus.
- 2.7 Type (6) – Fiberglass Flexible Blanket Insulation: Owens Corning All-Service Duct Wrap, 0.75 pound per cubic foot density, blanket type insulation with all service facing with a 2" min. stapling and taping flange on one edge. Temperature range -60°F to 250°F. Factory applied reinforced Foil-Kraft (FRK) vapor barrier. Odor free and resistant to growth of bacteria or fungus. Installed thicknesses and R-Values as indicated below.

(* hr-ft²-°F/Btu at 75°F mean temperature.) & (** Assumes 25% compression of insulation.)

Nominal			Installed	
Thickness,	Density	Out-of-Package	Thickness,	Installed

in.	pcf	R-Value*	in.	R-Value*
1 ½	.75	5.1	1 1/8	4.2
1 ½	1.0	5.6	1 1/8	4.5
1 ½	1.5	6.1	1 1/8	4.8
2	.75	6.8	1 ½	5.6
2	1.0	7.4	1 ½	6.0
2	1.5	8.2	1 ½	6.4
2 3/16	.75	7.5	1.65	6.0
3	.75	10.2	2 1/4	8.4
4	.75	14.7	3 1/4	12.0

- 2.8 Type (7) – Hydrous calcium silicate: ANSI/ASTM C533; rigid white; asbestos free; 'k' value of 0.44 at 300 degrees F, 15 pcf maximum dry density, 60 psi minimum compressive strength at 5 percent deformation. Aluminum jacket over straight sections of piping and fiberglass cloth jacket over fittings.
- 2.9 Type (9) - Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat faced on both major surfaces; maximum board size 48 inches by 96 inches; not less than 2 lbs/cu. ft. density per ASTM D 1622; not less than 20 psi compressive strength; factory-tapered insulation boards fabricated to slopes indicated. Flame Spread: Not greater than 50; ASTM E 84. Smoke Developed: Not greater than 170; ASTM E 84. Tapered Board Insulation: Fabricated to slope of 1/4 inch per 12 inches (1:48) or 1/2 inch per 12 inches (1:24) as noted on the details unless otherwise indicated.
- A. Insulation Fasteners: Factory-coated steel fasteners and metal plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening insulation and cover boards to substrates, acceptable to membrane manufacturer.
- 2.10 Type (12) - Flexible Elastomeric Insulation: Armaflex AP White Unslit (Flame/Smoke Rating 25/50 thru 1" thickness) Armaflex white foamed plastic flexible tubing insulation, Unslit. UV resistant thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature. Available ½" thick thru 2-5/8" ID and 3/4" or 1" thick thru 4-1/8" ID. See Execution for allowable locations of Lap Seal.
- A. Provide Armafix insulated pipe hangers at all pipe hangers.
- 2.11 JACKETS
- A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
- B. PVC Jackets: One piece, premolded type.
- C. Aluminum Jackets: ASTM B209; 0.032 inch thick; Stucco Embossed corrugated finish; 2-1/2" deep corrugations. Childers jacketing system, ITW Insulation system, or equal.
1. Finish and thickness are indicated in field-applied jacket schedules.
 2. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper or 2.5-mil thick polysurlyn.
 3. Moisture Barrier for Outdoor Applications: 2.5-mil thick polysurlyn.

- D. Vapor barrier mastic coatings:
 - 1. for outdoor service: Foster Division - 30-15
 - 2. for indoor service: Foster Division - 30-80 or 30-90 (water based)
 - 3. Or equal products by the following manufacturers:
 - a. Exxon Chemical Company USA
 - b. Insul - Coustic IC
 - c. Epolux-Cadalar
- E. Reinforced Polyvinyl-Chloride (PVC) Flashing Sheet: ASTM D 4434, Type III, fabric reinforced and fabric scrim-backed; felt backed; capable of being heat-welded. Sheet Thickness: 30 mils, nominal.
- F. Thermoplastic Polyolefin (TPO) Flashing Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet; free of surface defects and embossing or marking which affect membrane thickness or performance; capable of being heat-welded. Thickness: 60 mils, nominal. (For use on ductwork exterior location where indicated on the plans.)
- G. Removable/Reusable Valve Covers:
 - 1. Cover shall be factory fabricated of 1" close cell elastomeric insulation (Flame/Smoke rating less than 25/50 per ASTM E-84) with Velcro closures. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature. Cover shall overlap adjoining sections of pipe insulation and shall totally enclose all portions of the valve being covered. Installation shall not require the use of any special hand tools. As manufactured by Corick, Baton Rouge, Louisiana, or approved equal.

2.12 ACCESSORIES

- A. Insulation Bands: ¾ inch wide; 0.015 inch thick galvanized steel.
- B. Metal Jacket Bands: ¾ inch wide; 0.015 inch thick aluminum.
- C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- D. Finishing Cement: ASTM C449.
- E. Fibrous Glass Cloth: Untreated; 9 oz/sq yd weight.
- F. Adhesives/Tapes: Compatible with insulation.
- G. Flexible elastomeric foam finish-Armstrong FR/Armaflex finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION

- A. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
- B. Insulate all pipe, valves, and specialties except where insulation is specifically indicated to be omitted.
- C. All insulation shall be continuous through wall, floor, and ceiling openings and sleeves.

- D. Install insulation with all joints tightly butted (except expansion joints in hot applications).
- E. Piping insulation and jacketing shall be applied in accordance with MICA (Midwest Insulation Contractors Association) Plate #3 (b) requirements. Insulation at hangers shall be applied in accordance with MICA Plate #6A. Insulation for fittings, valves, flanges, and couplings shall be installed in accordance with MICA Plates 10-18.
- F. The open end of all insulation shall be neatly beveled either by beveling the insulation or by using finish cement.
- G. Prior to application of insulation, heat tracing, or painting; piping and equipment shall have been tested and accepted.
- H. All surfaces to be insulated shall be clean and dry. Special solvents are not required for use in cleaning, but any oil, grease, dirt or foreign material shall be wiped or scraped from the pipe or equipment surface. Insulation shall not be applied on damp or frosty surfaces.
- I. All pipe lines with hangers, saddles, etc., shall be set in their permanent location before insulation is applied. Should it be necessary to block or shore up pipe to install insulation, or should it be necessary to displace or remove hangers, the pipe and hangers shall be restored to their original location and alignment when the insulation is complete. Where pipe hangers are installed in a manner that prevents the specified insulation thickness to be installed, the pipe hangers shall be adjusted or moved and rehung to allow the specified insulation thickness to be applied.
- J. Where insulated piping is supported by hangers clamped directly to the pipe, the insulation shall be carefully fitted around hanger clamp and sealed at openings in jacket.
- K. For all cold service piping:
 - 1. Seal the beginning and end of each run of insulation to the pipe being insulated with vapor barrier mastic to prevent air from entering the space between the pipe and the insulation. This especially applies at connections to air handling units and similar equipment. See details on plans.
 - 2. Install a vapor stop on each side of all valves that are not fully encapsulated by the insulation including all valves where the stem or handle protrudes outside the insulation. The vapor stop shall consist a vapor barrier and mastic to prevent moisture from traveling longitudinally along the insulation in the space between the pipe and the insulation. See details on plans.
 - 3. Vapor retarder/seal shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder/seal shall be used to attach the vapor retarder/seal or jacketing. No wire ties capable of penetrating the vapor retarder/seal shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.
 - 4. Where cold service piping attaches to coils in air handling equipment, vapor seal the end of the insulation and seal insulation to air handling unit casing. Seal in accordance with air handling unit manufacturer's installation instructions or as directed by the Engineer.
 - 5. At pipe riser supports, where the support is clamped directly to the pipe, insulation shall be installed over the outside of the riser support clamp and shall totally enclose the riser clamp.

- L. Insulate heating and cooling coil headers located outside of units or ductwork or not located above a condensate pan as specified for piping.
- M. Unions, flanges and valves:
 - 1. All unions, flanges, valves and other similar fittings shall be insulated unless otherwise indicated.
 - 2. Extended Stems: Where insulation is indicated or specified, coordinate with contractor furnishing valves to furnish extended stems arranged to receive insulation. Cold service valves that are insulated with removable covers do not require extended stems.
 - 3. For all cold service piping:
 - a. Insulate all balance (flow control) valves, flow measuring devices, and stop valves (except valves located in mechanical rooms and valves exterior to the building) with molded, pre-shaped fiberglass insulation inserts and cover with a two piece PVC Fitting Cover. Insulation and fitting cover shall be removable. Secure the two piece PVC fitting cover by taping the ends to the adjacent pipe covering. All seams of cover shall be sealed with vapor barrier pressure sensitive color matched tape.
 - b. Insulate all balance (flow control) valves, flow measuring devices, and stop valves (except valves located in mechanical rooms and valves exterior to the building) with factory fabricated removable/reusable valve covers. Install in accordance with the manufacturer's instructions to prevent the condensation. All removable valve covers shall be the same manufacture.
- N. At pipe hangers, furnish and install a sheet metal protection shield and wooden inserts the same thickness as the insulation. Shields and blocks are intended to prevent the crushing of the insulation. Blocks shall be sealed to provide continuity of the vapor barrier.
 - 1. In lieu of the wooden blocks at pipe hangers, this Contractor may, at his option, provide rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket. Thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation lengths shall be three (3) times the pipe diameter plus 8" with a minimum length of 20". Insulation thickness shall be the same as the pipe insulation.
- O. Exterior Applications
 - 1. Type 1, 7 or 8: Cover with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.
 - 2. Type 2, 3 or 12: Coat with flexible elastomeric foam finish per manufacturer's instructions.

3.2 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes:
 - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
5. Only where Unslit Insulation cannot be installed and longitudinal slit is needed, provide Lap Seal insulation. The longitudinal slit should only be used when insulating existing piping.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange cellular glass insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.3 INSTALLATION OF EQUIPMENT INSULATION

- A. Install equipment insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

- D. Do not apply insulation to equipment while the equipment surface temperature is above or below ambient air temperature.
- E. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- I. Attachments beyond the insulation line on equipment such as stiffening rings shall be considered an integral part of the equipment and shall be insulated and finished in the same manner as the equipment proper. Thickness of insulation on such attachments and projections shall be the same as the adjoining insulation.
- J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of mastic or weather-barrier protective finish, or jacketing, as recommended by manufacturer.

3.4 DUCT INSULATION

- A. Installation shall comply with the manufacturer's recommendations using manufacturer's recommended procedures, adhesives, joint tape, and methods.
 - 1. For ducts 18" and larger in width, welding pins shall be used on not greater than 16" o.c. on the bottom and sides of the ducts and maximum 3" from insulation joints to prevent sagging. Pins shall be covered with duct tape. All parts of the duct system shall be insulated in such a manner to form a continuous insulation and prevent excessive heat loss, heat gain, or condensation.
 - 2. For ducts 18" and smaller, place pins along long individual centerline of duct. Space 3" inches maximum from insulation end joints and 16" inch on center.
- B. Ductwork Located Outdoors
 - 1. Exterior of ducts shall have rigid polyisocyanurate (Type 9) insulation secured to the outside with welding pins as described below. All seams shall be butted and taped.
 - a. On horizontal runs, bottom of ducts over 12" wide and/or sides over 16" in height shall be secured with welded pins and speed clips on a maximum of 15" centers.
 - b. On vertical runs, welded pins and speed clips shall be spaced on a maximum of 15" centers on all duct sides over 12".

- c. Mechanical fasteners shall start within 2" of leading edge of each section, and within 3" of the leading edge of all cross joints within the duct sections. Mechanical fasteners shall be flush with the liner surface.
2. Install an EDPM (Hypalon) waterproof membrane over entire exposed surface. Lap joints a minimum of 6" and seal with manufacturer's recommended double sided tape. Secure jacket to duct with adhesive. See detail on the plans.
3. Install an Aluminum Jacket over entire exposed surface. Lap joints per manufacturer's recommendation, minimum 2", and seal joints on top with Silicone sealant (see specification 230010) to prevent the entry of water from the top. Secure jacket with sheet metal screws so jacket may be removed and replaced; do not puncture the welded steel ducts underneath. Caulk all joints and screw heads.

3.5 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Ducts and Plenums:
 1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.040 inch thick.
 2. TPO
- C. Piping:
 1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.040 inch thick.

3.6 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.7 INSULATION THICKNESS

- A. The following equipment requires field applied insulation:
 1. The following piping requires field applied insulation:

System	Insulation Type	Thickness
Condensate Drain Lines (Inside Building)	3	1/2"
Refrigerant Suction Gas Piping	3	1/2"
Refrigerant Suction Gas Piping (attic)	3	3/4"
Refrigerant liquid piping on any piping lengths over 75ft	3	1/2"
Refrigerant liquid piping (attic)	3	3/4"
Refrigerant liquid piping (exterior)	12	1"

Refrigerant suction gas piping (exterior)	12	1"
Any Pipe Thru Rated Wall where Details Show This density is required	5	Match thickness above

2. The following ductwork requires field applied insulation:

System	Insulation Type	Thickness
Supply plenum boxes attached to Slot grilles where not located within a return plenum	6	1-1/2"
Supply grilles where located in attic or Unconditioned space	6	1-1/2"
All supply air ductwork above ceilings, in chases, and other concealed locations	4 (rect only) 6	1" 1-1/2"
All Return air ductwork above ceilings, in chases, and other concealed locations	4 (rect only) 6	1" 1-1/2"
All Outside Air ductwork above ceilings, in chases, and other concealed locations	4 (rect only) 6	2" 2"
All supply and return ductwork in Equipment rooms unless lined	4 5 6 (round)	1" 1" 1-1/2"
Round and Rectangular Outside Air ductwork in Equipment rooms unless lined	4 5 6 (round)	2" 2" 2"
Round and Rectangular supply and return ductwork located outdoors. Jacket with flashing	9 5	2" 2"
For exterior rectangular duct over 30" wide use below		
Rectangular supply and return ductwork located outdoors. Jacket with flashing	9 9 on top of duct	2" tapered

END OF SECTION 230200

SECTION 230400 – HVAC FANS**PART 1 GENERAL****1.1 SUMMARY****A. Section Includes**

1. The ceiling-mounted circulation fan is the model scheduled with the capacities indicated. The fan shall be furnished with standard mounting hardware and variable speed control to provide cooling and destratification.

B. Summary of Work

1. Installation of the fan, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others. Factory installation services are available through Big Ass Fans. Consult the appropriate installation scope of work for information on the available factory installation options, overview of customer and installer responsibilities, and details on installation site requirements.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation

1.3 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. Underwriters Laboratories (UL)
- C. Restriction of Hazardous Substances (RoHS)
- D. Canadian Standards Association (CSA)
- E. International Organization for Standardization (ISO)
- F. National Electrical Manufacturers Association (NEMA)
- G. National Electrical Code (NEC)

1.4 SUBMITTALS

- A. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods.
- B. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information.
- C. Installation Guide: The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan. All data is subject to change without notice.
- D. Schedule

- E. Ceiling fan sizing, placement, and performance shall be verified using computational fluid dynamics (CFD) analysis. At a minimum, the input data for the CFD analysis shall include the ceiling fan(s), significant obstructions to airflow at the floor level, and the actual space dimensions. As verification of performance, the submittal shall include results of the CFD analysis including, at a minimum, the following performance metrics determined in accordance with ANSI/ASHRAE Standard 55-2017: average air speed, minimum, maximum and average cooling effect from elevated air speed, Predicted Mean Vote, and Predicted Percentage Dissatisfied for seated and standing occupants in each occupied zone.

1.5 QUALITY ASSURANCE

A. Certifications

- 1. The fan assembly, as a system, shall be Intertek/ETL-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
- 2. The fan shall be compliant with NFPA 13—Standard for the Installation of Sprinkler Systems, NFPA 72—National Fire Alarm and Signaling Code, and NFPA 70-2011—National Electrical Code (NEC).
- 3. Controllers shall comply with National Electrical Code (NEC) and Underwriters Laboratory (UL) standards and shall be labeled where required by code.

B. Manufacturer Qualifications

- 1. The fan and any accessories shall be supplied by Big Ass Fans, which has a minimum of ten (10) years of product experience.
- 2. ISO 9001-certified
- 3. The manufacturer shall not be listed on the Air Movement and Control Association International Inc. (AMCA) Certified Ratings Program (CRP) Non-Licensed Products report in the previous 36 months.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
- B. The fan and its components shall be stored in a safe, dry location until installation.

1.7 WARRANTY

- A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the Big Ass Fans Warranty in accordance to the following schedule:

Mechanical	7 years
Electrical	3 years (standard); 7 years (extended)
Labor	1 year

- B. The warranty shall not require the submission of a post installation form or photographs of the installed fan(s) to the manufacturer for the warranty to be in effect.
- C. The warranty shall not require the periodic submission of maintenance records for the warranty to remain in effect.

PART 2 - PRODUCT

2.1 MANUFACTURER

- A. Destratification fan selection has been based on Big Ass Fans to establish the desired quality, style, and type. Equal products, complying with these specifications are acceptable.

2.2 HIGH VOLUME, LOW SPEED FANS

A. Complete Unit

1. Regulatory Requirements: The entire fan assembly shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification in industrial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Airfoil System

1. The fan shall be equipped with six (6) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.
2. The fan shall be equipped with six (6) Powerfoil winglets on the ends of the airfoils. The winglets shall be molded of a polypropylene blend. The standard color of the winglet shall be "Safety Yellow."

C. Motor

1. The fan motor shall be an AC induction type inverter rated at 1725 RPM, 200–240/400–480 VAC, 50/60 Hz, three-phase.
2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP56. A B5 standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 5⁰ F to 104⁰ F (-15⁰ C to 40⁰ C) ambient conditions.

D. Gearbox

1. The gearbox shall be a helical gear reducer, precision finished from hardened steel for low noise and long service life with double lip seals to retain oil and prevent contamination. The gearbox shall be lubricated for life. The gear reducer shall have a standard backlash of less than 25 arc minutes and be equipped with a 17-4 stainless steel shaft of 1-1/4" (3.2 cm) diameter.

E. Motor Frame

1. The motor frame and mount shall be constructed of steel and powder coated for corrosion resistance and appearance.

F. Mounting System

1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is installed to the mounting structure to ensure the fan will hang level from the structure.
2. The upper mount shall be of ASTM A-36 steel, welded construction, at least 3/16" thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.
3. All mounting bolts shall be SAE Grade 8 or equivalent.

G. Hub

1. The fan hub shall be 19" (48 cm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, six (6) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.
2. The hub shall be secured to the output shaft of the gearbox by means of a steel coupling interface. The hub shall incorporate three (3) safety retaining clips made of 1/4" (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

H. Safety Cables

1. The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of $\varnothing 3/8$ " (1 cm).
2. The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4" (0.6 cm).
3. The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress[®] sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
4. Field construction of safety cables is not permitted.

H. Variable Frequency Drive

1. The Variable Frequency Drive (VFD) shall be a NEMA 4X VFD that is factory programmed to minimize starting and braking torques. The VFD shall have touchpad controls and an LED display for controlling the fan's direction, operation, speed, and programming. The VFD may be equipped with an EMI/RFI filter to limit interference with other electronic equipment and a rotary switch disconnect for lock-out/tag-out requirements.
2. Onboard Variable Frequency Drive: The VFD may be mounted on the fan motor frame. A wall-mounted remote keypad equipped with touchpad controls and an LED display shall be provided for such installations, allowing access to all VFD functions.
3. Wall-Mounted Variable Frequency Drive: The VFD may be wall-mounted for ease of access.

I. Fire Control Panel Integration

1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

J. Guy Wires

1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

K. Controller

1. Provide wall mounted controller for each fan.
2. Controller shall allow for user control of the following:
 - i. On/off fan control
 - ii. Fan speed selection (0-10 speed dial or similar)
 - iii. Fan rotation direction (forward/reverse)

PART 3 EXECUTION

3.1 PREPARATION

- A. Fan location shall have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
- B. Mounting structure shall be able to support weight and operational torque of fan. Consult structural engineer if necessary.
- C. Fan location shall be free from obstacles such as lights, cables, or other building components.
- D. Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.
- E. Each fan requires dedicated branch circuit protection.

3.2 INSTALLATION

- A. The fan shall be installed by a factory-certified installer according to the manufacturer's Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle irons for bar joist applications. Big Ass Fans recommends consulting a structural engineer for installation methods outside the manufacturer's recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.
- B. Minimum Distances
 - 1. Airfoils must be at least 10 ft (3 m) above the floor.
 - 2. Installation area must be free of obstructions such as lights, cables, sprinklers, or other building structures with the airfoils at least 2 ft (0.61 m) clear of all obstructions.
- C. The fan shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters. Additional details are in the Big Ass Fans Installation Manual.
- D. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
 - 1. The maximum fan diameter shall be 24 ft (7.3 m).
 - 2. The HVLS fan shall be centered approximately between four adjacent sprinklers.
 - 3. The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft (0.9 m).
 - 4. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72—National Fire Alarm and Signaling Code.
- E. COMMISSIONING
 - 1. Remove shipping restraints, blocking, and bracing.
 - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete.
 - 3. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 4. Verify proper motor rotation direction and that fan wheel is free to rotate and bearings operate smoothly.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Measure and record motor electrical values for voltage and amperage.
 - 7. Confirm fan direction is reversible. Confirm fan responds to changes made at controller.

END OF SECTION 230400

SECTION 230610 – FAN COIL UNITS**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Furnish all labor, services, material and related items necessary to complete the fan coil installation indicated on the drawings and/or specified herein.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230900 - Air Distribution.
- E. Section 230960 - Temperature Controls.
- F. ANSI/NFPA 70 National Electrical Code.
- G. ANSI/AMCA Standard 204-05 - "Balance Quality and Vibration Levels for Fans".

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fan coil units of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. All units shall be rated and certified as complete units in accordance with ARI Standard 240, and shall bear the ARI seal. Chilled water coils shall be ARI certified under ARI Standard 410.
- C. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate U.L. label.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Shop drawings shall indicate complete assembly, unit dimensions, weight loading, required clearances, details of construction, and location and size of field connections.
- C. Product data shall indicate typical catalog of information including optional components and arrangement, unit size, capacities at scheduled conditions, ratings, fan performance, motor electrical characteristics, and gages and finishes of materials.
- D. Submit sound power levels by octave band for both fan outlet and casing radiation at rated capacity.

- E. Submit product data including coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- F. Submit manufacturer's certificate that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.
- G. Submit product data of filter media, filter performance data, filter assembly, and filter frames.
- H. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- I. Submit manufacturer's installation instructions.
- J. Submit operation and maintenance data under provisions of Section 230000 including start-up instructions, instructions for lubrication, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

1.5 STORAGE AND HANDLING

- A. Hoist fan coil units to the location where they will be installed.
- B. Handle fan coil units and components carefully to prevent damage, breakage, denting and scoring. Do not install damaged fan coil units or components; replace with new. Comply with manufacturer's rigging and installation instructions for unloading fan coil units, and transporting them to final location.
- C. Store in a clean, dry place and protect units from damage by weather, dirt, fumes, construction debris, water, and physical damage.

PART 2 - PRODUCTS

2.1 CONCEALED FAN COIL UNITS

- A. Fan coil units suspended above the ceiling have been selected based on manufacturer scheduled to establish the desired style, quality, performance and type. Products by the following manufacturers will be accepted if the product complies with these specifications:
 - 1. Daikin
 - 2. Trane
 - 3. Carrier
 - 4. York
- B. Fan coil units shall include the following:
 - 1. 20 gauge galvanized unit casing.
 - 2. ½" fiberglass insulation, neoprene coated.
 - 3. Front discharge collar.
 - 4. Back inlet return air plenum.
 - 5. Mounting holes.

6. Insulated drain pan. Drain pan shall be insulated with the equivalent of 1" of fiberglass. Drain pan shall be constructed from welded galvanized sheet metal, or equal, coated for corrosion protection.
 7. Permanent split capacitor motors, sleeve bearings with oilers, inherent thermal overload protection with automatic reset.
 8. Fan and motor resiliently mounted.
 9. U.L. listed.
 10. Integral direct expansion coil.
 11. Fans shall be forward curved DWDI, centrifugal type.
 12. Three-speed fan speed control switch for field mounting.
 13. Factory mounted and wired non-fused disconnect switch.
 14. Rubber-in-shear vibration isolators.
 15. Drain pan extended under control valves.
- C. Fan motor power input shall not exceed the power indicated in the fan coil unit schedule.
- D. Fan speed shall not exceed 1100 rpm.
- E. Fan coil units shall be ARI rated.
- F. Provide throwaway filters. Filter housings shall be arranged to allow for bottom or back filter removal as required for ease of filter changing.

PART 3 - EXECUTION

- 3.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fan coil units. Do not proceed until unsatisfactory conditions have been corrected.
- 3.2 Install fan coil units level and plumb, in accordance with manufacturer's written instructions.
- 3.3 Arrange installation of fan coil units to provide access space around units for service and maintenance.
- 3.4 Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.
- 3.5 Electrical Connections: The following requirements apply:
- A. Electrical power wiring is specified in Division 26.
 - B. Temperature control wiring and interlock wiring is specified in Division 23 section automatic temperature control system.
 - C. Grounding: Connect unit components to ground in accordance with the National Electrical Code.
- 3.6 Adjust damper linkages for proper damper operation.
- 3.7 Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

- 3.8 Refer to Sections 230910, "Start-up, Cleaning and Testing", 230930 "Balancing" and 230960 "Temperature Controls" for procedures for air-handling-system testing, adjusting, and balancing.

END OF SECTION 230610

SECTION 230630 – VENTILATION EQUIPMENT**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the exhaust fan installation indicated on the drawings and/or specified herein.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. Vibration Levels: Comply with ANSI/AMCA Standard 204-05, "Balance Quality and Vibration Levels for Fans".
- D. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
 - 1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 - 2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 QUALITY CONTROL

- A. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210 - Laboratory Methods of Testing Fans for Rating.
- B. Sound Power Level Ratings:
 - 1. Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data."
 - 2. Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating."
 - 3. Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
- C. UL Compliance:
 - 1. Fans and components shall be UL listed and labeled.

2. Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
- D. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code".

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Section 230000.
 1. Product data for selected models, including accessories.
 2. Shop drawings detailing equipment assemblies and indicating dimensions, weights, required clearance, components, and location and size of field connections.
 3. Materials gauges and finishes.
 4. Roof curb dimensional data and provisions for flashing.
 5. Motor ratings and electrical characteristics plus motor accessories.
 6. Wiring diagrams that detail power and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
 7. Data for inclusion in Operating and Maintenance Manual specified in Section 230000.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units on site from physical damage.
- C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

PART 2 - PRODUCTS

2.1 FANS, GENERAL

- A. General: Provide factory fabricated, assembled, tested, and finished fans with indicated capacities and characteristics.
- B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
- C. Fan Shaft: Turned, ground, and polished steel, keyed to wheel hub, designed to operate at not more than 70 percent of the first critical speed at the top of the speed range of the fan's class.
- D. Guards: For motors mounted on the outside of the fan cabinet. Galvanized steel, expanded metal with reinforced edges on inlet and outlet except not required on outlet if unit is equipped with gravity shutter.
- E. Shaft Bearings: Provide Type indicated, having a median life "Rating Life" (AFBMA L10) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.
- F. Factory Finish: The following finishes are required for all parts that are not aluminum:

1. Sheet Metal Parts: Prime coating prior to final assembly.
 2. Exterior Surfaces: Baked-enamel finish coat after assembly.
- G. Motors: Motors shall be in accordance with Section 230050. Minimum sizes and electrical characteristics as indicated. If not indicated, motors shall be large enough so that the driven load will not require the motor to operate in the service factor range.
- H. Motor Bases shall be adjustable to allow for adjustment of belt tension.
- I. Starters, Electrical Devices, Wiring and connections are specified in Division 26. Disconnect devices are specified below.
- J. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 5 percent, from specified criteria.
- K. Accessories (where indicated on plans):
1. Thermostat. Line voltage, rated for 8 amps at 120 vac. Normally open contacts close as temperature rises. Honeywell model T651A or equal.
 2. Humidistat. Line voltage, rated for 7.5 amps at 120 vac. Normally open contacts close as humidity rises. Honeywell model H46C or equal.
 3. Wall mounted fan speed control rated for 15 amps at 120 vac that can reduce the fan to 60% of the rated airflow.
- L. Fan selections have been based on the manufacturer scheduled to establish the desired type, quality, and performance. Equivalent products by the following manufacturers are acceptable:
1. Greenheck Fan and Ventilator Company
 2. Loren Cook Company
 3. Penn Ventilator
 4. Acme
 5. Jenn Air
 6. New York Blower
 7. Twin City

2.2 CEILING MOUNTED AND CABINET FANS

- A. General Description: Centrifugal fan designed for installation in ceiling, wall, or concealed inline applications.
- B. Housing: Galvanized steel lined with 1/2" acoustical liner.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Fan motor shall be mounted on vibration isolators.
- E. Plug-in type disconnect.
- F. Aluminum grille with a white enamel finish.
- G. U.L. listed.

H. Back draft damper.

2.3 PROPELLER FANS

A. General Description: Belt-driven or direct-drive propeller fans, as indicated, consisting of fan blades, hub, housing, orifice ring, motor, drive, and accessories.

B. Fan Wheel:

1. Wheels: Formed-steel blades riveted to a heavy-gage steel spider bolted to cast-iron hub.
or
2. Fan Wheel: Replaceable, cast-aluminum blades fastened to cast-aluminum hub. Factory set pitch angle of blades.
or
3. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub. Factory set pitch angle of blades.

C. Fans shall be suitable for mounting as shown on the plans.

D. Motor shall be mounted on a heavy gauge steel frame bolted to a heavy gauge steel mounting frame. Mounting frame shall be all welded construction, suitably reinforced for the duty intended.

E. Accessories:

1. Non-fused disconnect switch, factory mounted and wired.
2. OSHA approved guard on the inlet side of the fan.
3. Gravity, as specified below backdraft damper on the discharge side of the fan.
4. Steel, wall mounting sleeve.

2.4 BACKDRAFT DAMPERS

A. Backdraft dampers shall comply with the following:

1. General Description: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base or at discharge of wall fan, factory set to close when fan stops.
2. Blades: extruded aluminum, 0.070" thick with extruded vinyl edge seals.
3. Frame: extruded aluminum, 0.125" wall thickness.
4. Linkage: 1/2" tie bars.
5. Bearings: Synthetic.
6. Temperature Range: -40°F to 200°F.
7. Maximum face velocity: 3500 FPM.
8. Maximum Leakage: 12 CFM per square foot at 1/2" W.G. differential.
9. Dampers shall be Ruskin Model BD6 Heavy Duty Backdraft Dampers or approved equal.

PART 3 - EXECUTION

3.1 Handle Fans carefully to avoid damage to components, enclosures and finish. Do not install damaged components; replace and return damaged components to equipment manufacturer.

Store Power Ventilators and Fans in clean dry place and protect from weather and construction traffic.

- 3.2 Install Fans where indicated, in accordance with equipment manufacturer's installation instructions and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes. Exhaust fan outlets shall be installed a minimum of 10'-0" away from any outside air intakes for HVAC systems (i.e.: intakes on rooftop units, intake caps or goosenecks, intake louvers, etc.) and any operable windows.

3.3 INSTALLATION

- A. Suspended Units: Fans shall be suspended from structure using threaded steel rods and vibration isolators. Isolators shall be furnished under Section 230020.
- B. Floor Mounted units: Support fans on vibration isolators as indicated in Section 230020. Anchor isolators to concrete floor per manufacturer's instructions or as indicated.

- 3.4 Install fans with flexible duct connections. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

- 3.5 See Section 230930 for air balancing. Provide replacement fixed sheaves and belts where required for final air balance. Size replacement sheaves to obtain required performance.

3.6 FINAL CHECKS BEFORE START-UP

- A. Remove shipping restraints, blocking, and bracing.
- B. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete.
- C. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
- D. Verify proper motor rotation direction and that fan wheel is free to rotate and bearings operate smoothly.
- E. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
- F. Verify manual and automatic volume control dampers in connected ductwork systems are in the full-open position.

END OF SECTION 230630

SECTION 230645 - RESIDENTIAL KITCHEN VENTILATION EQUIPMENT**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the kitchen ventilation equipment work indicated on the drawings and/or specified herein.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230900 - Air Distribution.

1.3 QUALITY CONTROL

- A. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210 - Laboratory Methods of Testing Fans for Rating.
- B. Vibration Levels: Comply with ANSI/AMCA Standard 204-05, "Balance Quality and Vibration Levels for Fans".
- C. Sound Power Level Ratings:
 - 1. Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data."
 - 2. Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating."
 - 3. Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
- D. UL Compliance:
 - 1. Unit shall be UL 300A approved.
 - 2. Fans and components shall be UL listed and labeled.
 - 3. Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
- E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code".

1.4 SUBMITTALS:

- A. General: Submit the following in accordance with Section 230000.
 - 1. Product data for selected models, including accessories.
 - 2. Motor ratings and electrical characteristics plus motor accessories.
 - 3. Wiring diagrams that detail power and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

4. Data for inclusion in Operating and Maintenance Manual specified in Section 230000.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units on site from physical damage.
- C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

PART 2 - PRODUCTS

2.1 RESIDENTIAL KITCHEN HOOD

- A. Selection has been based on the manufacturer scheduled to establish the desired type, quality and performance. Equivalent products by the following manufacturers complying with these specifications are acceptable: Greenheck or Denlar.
- B. Kitchen ventilation hood(s) shall:
 1. be of the exhaust only type, residential range hood with integral fire suppression.
 2. be constructed of a minimum of 20 gauge, type 304 stainless steel with a #3 finish.
 3. have seams on the canopy that are welded liquid tight. All exposed external welds shall be ground and polished to match the original finish of the metal. Lighter material gauges, alternate material types and finishes (400 series stainless steel, cold rolled steel, etc.) and non-liquid tight welding (tack weld, spot weld, etc.) are not acceptable.
 4. have construction that includes corrosion-resistant steel framing members for strength. All unexposed interior surfaces shall be constructed of a minimum 18 gauge corrosion-resistant steel, including but not limited to ducts, plenum, framing and brackets.
- C. Hood filter housings and filters shall be the following type:
 1. Grease Baffle shall:
 - a. be type 304 stainless steel.
 - b. shall terminate in a removable drip cup.
- D. Hood lighting shall:
 1. Lighting Fixtures: Recessed fixture with 60w shatter-proof bulb. Include ballasts and drivers as needed for the fixture type.
 - a. Light switch shall be mounted on hood
 2. have wiring that conforms to the requirements of the National Electrical Code (NEC #70-Latest Edition).
- E. The exhaust airflow shall be as scheduled.

F. Options

1. Control Panel: Provide a control panel on the end of the hood(s) that contains electrical controls and fire extinguishing system controls and a tank for the fire system wet chemicals. The electrical controls shall start/stop the associated exhaust fans.

2.2 KITCHEN HOOD FIRE EXTINGUISHING SYSTEM

- A. This Contractor shall furnish and install a wet chemical fire extinguishing system for the kitchen hood(s). System shall be Amerex. The hood(s) shall contain a factory engineered and pre-piped, U.L. Listed, Wet Chemical, Amerex 660 fire suppression system.
- B. The system piping shall be factory installed in the hood.
- C. A certified local Amerex distributor shall be selected by the factory for final system hook-up. The hood manufacturer shall be responsible for the coordination between the contractor and the Amerex distributor for the final field hook-up and certification of the fire suppression system.
- D. The system shall:
 1. Be capable of automatic detection and actuation and/or remote manual actuation.
 2. Have the fire suppression capabilities to protect the plenum(s), filter area(s) and cooking equipment. Accessories shall be provided for mechanical or electrical gas line shut-off applications and a double-pole, double-throw micro switch for activation of a shunt trip breaker (provided by others) for electrical equipment.
 3. Include the release assembly, agent tank, detectors, fusible links, liquid tight fittings, and remote manual pull station.
- E. System shall comply with the following:
 1. Manual pull station kit.
 2. System shall be the wet chemical type.
 3. System shall have duct, hood and surface protection.
 4. Audible alarm.
 5. Chemical cylinder with mechanical control.
 6. Fan speed controller.

2.3 WALL KITCHEN EXHAUST FAN

- A. Wall kitchen exhaust fan shall be provided by hood manufacturer.
 1. Fan shall have ECM motor.

PART 3 - EXECUTION

- 3.1 Hood and Fire Suppression System shall meet the requirements of the local authorities.

3.2 INSTALLATION

- A. Wall Mounted Units: Secure to wall plate with cadmium-plated hardware.
- B. Install exhaust a minimum of 10' away from any make-up air intakes, building walls or parapets. Fans shall be directed away from or perpendicular to building walls or parapets.

3.3 COMMISSIONING

- A. Perform the following operations and checks before start-up:
 - 1. Remove shipping, blocking, and bracing.
 - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starter, and disconnects.
 - 3. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operation. Align belts and install belt guards.
 - 4. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 5. Measure and record electrical motor voltage and amperage for each phase.

END OF SECTION 230645

SECTION 230650 – TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of work required by this section is indicated on schedules and by requirements of this section.
- B. Types of terminals specified in this section include the following:
 - 1. VAV terminals. (VAV)

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Material and Methods.
- D. Section 230020 - Vibration Isolators.
- E. Section 230900 - Ductwork.
- F. Section 230910 - Start-up, Cleaning and Testing.
- G. Section 230930 - Balancing.
- H. Section 230960 -Temperature Controls.

1.3 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 - Factory-Made Air Ducts and Connectors.
- C. ADC 1062 - Air Distribution and Control Device Test Code.
- D. ASHRAE Compliance:
 - 1. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units. Refer to ASHRAE Standard 52.1 for definitions of face velocity, net effective filtering area, media velocity, resistance (pressure drop), atmospheric dust spot efficiency and dust-holding capacity. ASHRAE Standard 52.1 measures arrestance, dust spot efficiency and dust holding capacity of filters. Refer to ASHRAE Standard 52.2-1999 for definitions of MERV (Minimum Efficiency Reporting Value) PSE (Particle Size Efficiency) and particle size ranges for each MERV number. ASHRAE Standard 52.2 measures particle size efficiency (PSE).

1.4 SUBMITTALS

- A. Submit under provisions of Section 230000.
- B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
- C. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and NC designation.
- D. Submit discharge and radiated Sound Power Level data re: 10 -12 watts for octave bands 2 through 7 at inlet static pressures of 1.0 inch W.G. for each terminal unit.
- E. Submit manufacturer's installation instructions.
- F. Submit operation and maintenance data.
- G. Submit operating instructions, maintenance and repair data, and parts lists.
- H. Submit calibration certification documentation of factory installed temperature, humidity, enthalpy and CO2 control sensors.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle units carefully to prevent damage. Do not install damaged components; replace with new.
- B. Store and protect products in clean, dry place. Protect from dirt, construction debris, and physical damage.
- C. Comply with manufacturer's installation instructions for rigging, unloading, hoisting and transporting units.

1.7 WARRANTY

- A. Provide one year warranty under provisions of "General Conditions."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Terminal unit selection has been based on the manufacturer scheduled to establish the desired type, quality, and performance. Equal products, complying with these specifications by the following manufacturers are acceptable:
 - 1. Price
 - 2. Titus
 - 3. Trane

4. Carrier
5. Nailor
6. Tuttle & Bailey
7. Anemostat

2.2 GENERAL

- A. Provide ceiling mounted terminal units of the following types
 1. VAV terminals with electric heating coils.
- B. Identify each airflow unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set air flow, minimum factory set air flow, and coil type.
- C. Terminals (except Laboratory exhaust terminals) shall include a multi-point, center averaging plastic sensor with static and total pressure sensor connections extended to outside of the terminal casing and gauge taps for flow measurement and balancing. Laboratory exhaust terminals shall include flow sensor as indicated below.
- D. Performance shall be based on tests conducted in accordance with ADC 1062.
- E. Maximum Casing Leakage: 2 percent of design air flow at rated inlet static pressure.
- F. Maximum Damper Leakage: 4 cfm air flow at one (1.0) inch W.G. inlet static pressure except where otherwise indicated.
- G. Units shall supply the indicated airflow at the pressure drop indicated on the plans; pressure drop includes the terminal unit and heating coil. Pressure drop of the terminal unit and reheat coil shall not exceed 0.25" w.c.
- H. Construct volume damper from an elastomeric gasket sandwiched between two layers of 22 gage galvanized steel except as indicated otherwise for laboratory exhaust valves. Key damper blades into shaft. Support shaft with Delrin® self-lubricating or brass fitted bearings.
- I. Heating Coils:
 1. Electric Heating Coil
 - a. Electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be UL listed. Coil shall be integral with the terminal. Elements shall be derated nickel chrome 80/20, supported by ceramic isolators a maximum of 3.5" apart staggered for maximum element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door.
 - b. Provide automatic reset thermal cutout differential pressure airflow switch for proof of flow and integral door interlock type disconnect switch which will not allow the access door to be opened while power is on. All individual components shall be UL listed.
 - c. Provide manual reset secondary thermal cutouts and magnetic contactors for each step, mounted and wired within the control enclosure.

- d. Airflow switch for proof of airflow.
- e. Fuses in terminal box for overcurrent protection
- f. Magnetic contactor for each step of control.

J. DDC Controls

- 1. Terminal units shall be furnished with DDC controls furnished by the Temperature Control Contractor (TCC) and installed by the terminal unit manufacturer. See Section 230960, Temperature Controls for related information.
- 2. DDC controls shall connect to the static and total pressure sensor connections furnished with the terminal unit with UL listed fire retardant (FR) type pneumatic tubing.
- 3. Provide controls in NEMA-1 enclosure with access panel sealed from air flow and mounted on side of unit. Locate DDC control unit inside NEMA-1 enclosure.
- 4. When controls are to be mounted by the terminal units manufacturer, TCC shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.
- 5. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer.

K. Electrical Power

- 1. Three phase units shall be fed with a 4 wire feeder.

2.3 SINGLE DUCT VAV SUPPLY TERMINALS

A. Casings: Minimum 22 gage (0.0336 inches) galvanized steel.

- 1. Air Inlets: Round/oval stub connections for duct attachment.
- 2. Air Outlets: Rectangular S and drive duct connections.

B. Lining: Adhesive attached, 1 inch thick neoprene or foil faced fibrous glass liner complying with ASTM C 1071, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements. Maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Line attenuator sections with 2 inch thick insulation.

C. Provide air volume damper, flow sensor for DDC controls furnished under Section 230960 (Temperature Controls) in a NEMA 1 enclosure with hinged access door for the Section 230960 controls to be mounted in.

D. Sound Levels

- 1. Discharge sound levels shall not exceed following levels (Db re 10 to the -12 power watts): (Based on NC-35 at 0.5 inch w.g. pressure drop when the discharge duct is

internally lined with 1.5 psf insulation for 5 feet downstream of terminal unit. An allowance of 8 db for room absorption is included in this NC requirement.)

OCTAVE BAND	2	3	4	5	6	7
	69	65	64	58	59	55

2. Radiated sound power levels with the fans operating shall not exceed the following levels (Db re 10 to the -12 power watts):

OCTAVE BAND	2	3	4	5	6	7
	69	65	64	58	59	55

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Terminal units shall be installed straight and level, and shall be free of vibration and noise when the system is operating at rated capacity.
- B. Arrange installation to provide access space around units for service and maintenance. Coordinate with other trades to provide 36" horizontal access to fan section, filter section, and controls, unless otherwise approved by the Engineer.
- C. Provide ceiling access doors or locate units above removable ceilings.
- D. Support units individually from structure. Do not support from adjacent ductwork. VAV units shall be supported as ductwork. Fan Terminal Units shall be supported with isolators in accordance with Section 230020, Vibration Isolation.
- E. Connect to ductwork with flexible duct at inlet in accordance with Section 230900.
- F. Provide minimum of 5 ft of one inch thick lined ductwork downstream of units.
- G. The variable volume controller shall be installed to operate with the central control system. Work shall be coordinated so that when the installation is complete; all items are properly installed and functioning.

3.2 ADJUSTING

- A. When controls are furnished by the terminal manufacturer, adjust flow range modulation from 100 percent of design flow to minimum flow indicated on plans. Set units with heating coils for heating flow indicated. When controls are furnished by the Temperature Control Contractor, these adjustments are part of Section 230960, Temperature Controls.
- B. Final Adjustment: After completion of installation, adjust thermostats, motors and similar equipment provided as work of this section.

3.3 CLOSEOUT PROCEDURES

- A. Provide services of manufacturer's technical representative for one 4-hour day to instruct Owner's personnel in operation and maintenance of terminal units.

END OF SECTION 230650

SECTION 230671 – GAS FIRED HEATERS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the gas fired heater installation indicated on the drawings and/or specified herein. This section includes the following:
 - 1. Gas Fired Unit Heaters.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230890 - Breechings, Chimneys, and Stacks.
- F. Section 230960 - Temperature Controls.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Section 230000.
- B. Product data including weights, dimensions, metal gauges, and data on features and components. Include plan and elevation views of units, minimum clearances, and data on ratings and capacities.
- C. Wiring diagrams from manufacturers detailing requirements for electrical power and control wiring for heaters. Include ladder-type wiring diagrams for interlock and control wiring required for field installation. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
- D. Data for inclusion in Operating and Maintenance Manual specified in Section 230000.
- E. Include calibration certification documentation of factory installed temperature, humidity, enthalpy and CO2 control sensors.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, "National Electrical Code."
- B. Gas-Fired Heaters and Accessory Items: NFPA 54, "National Fuel Gas Code."
- C. AGA Approval: Heaters design certified and labeled by the American Gas Association.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Unit selection has been based on the manufacturer scheduled to establish the desired style and quality. Products by the following manufacturers, complying with these specifications, are acceptable:
 - 1. Gas Unit Heaters:
 - a. Reznor
 - b. Modine Mfg. Co.
 - c. Hastings

2.2 GAS FIRED HEATERS, GENERAL

- A. Types, Minimum Ratings, Locations, and Mountings: As indicated.
- B. Type of Gas: Heaters designed and built to burn natural gas with characteristics the same as those of the gas available at the Project site.
- C. Assembly and Wiring: Heaters factory assembled, piped, wired, and tested.
- D. Heater Electrical Rating: 115 V a.c. except as otherwise indicated.
- E. Fans: Drawings indicate the type of fan required. Where no type is indicated, provide centrifugal fans.
- F. Centrifugal Fans: Where indicated, provide factory-balanced, resilient-mounted, steel, belt driven with adjustable-pitch motor sheave, belt guard and blower inlet guards on both sides of fan.
- G. Motors: Totally enclosed with internal thermal overload protection.
- H. Control Transformer: Integrally mounted. 115 V a.c./24 V a.c.
- I. Temperature Control: See Section 230960 Temperature Controls
- J. Finishes: External Casings and Cabinets shall have baked enamel over corrosion-resistant treated surface.

2.3 GAS FIRED UNIT HEATERS

- A. General: Comply with ANSI Z83.8, "Gas Unit Heaters."
- B. Housing: Steel, with integral draft hood (gravity vented units only) and inserts for suspension mounting rods.
- C. Venting Provision:
 - 1. Factory installed power venter with sealed flue product collection chamber. Flue fan shall be capable of venting up to 90 equivalent feet from unit.

- D. Burners: Cast iron or aluminized steel with stainless-steel inserts.
- E. Automatic Fan Thermal Switch: Delays fan start until discharge air is heated. Delays fan shutdown until air cools to comfort threshold.
- F. Heat Exchanger: Aluminized steel
- G. Automatic Gas Control: Single-stage, 24 VAC. valve. Unit shall include factory mounted and AGA approved piped gas train. Provide thermal activated, 100% safety shut-off gas valve. Gas train shall be suitable for an inlet gas pressure between 10" w.c. and 5" w.c.
- H. Ignition: Electronically controlled spark with flame sensor.
- I. Discharge: As indicated on plans:
 - 1. Discharge Louvers: 4-way, independently adjustable horizontal and vertical blades.
- J. Operating Controls:
 - 1. Thermostat shall control burner operation to maintain room temperature settings. Provide terminal strip for connection of field wiring. See Section 230960, Temperature Controls, for thermostat requirements.
 - 2. Provide high limit control, with fixed stop at maximum permissible setting, to de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
 - 3. Provide controls for supply fan to cycle to control bonnet temperature independent of burner controls. Include manual switch for continuous fan operation. Include provision for Owner's EMS system to start supply fan in parallel with factory wired controls to allow Owner to operate fan continuously from a remote location.
 - 4. Provide blocked vent switch (gravity vented units) or combustion air switch (power vented units) to verify proper vent flow before opening the gas valve.
- K. All unit mounted controls shall be factory installed and wired, complete and ready for operation. Unit shall be capable of operating from a single electrical power connection as scheduled on the drawings, with all other voltage requirements being provided internally by a factory installed transformer. Unit mounted controls shall include all necessary safety and operating controls including, but not necessarily be limited to:
 - 1. High limit.
 - 2. Fan control.
 - 3. Motor thermal overloads.

2.4 CONTROLS

- A. Pre-wire unit so connection of power supply and field wiring from unit to remote control panel shall make unit operative.
- B. Provide remote control panel with on-off switch, summer-winter switch, indicating lights for supply fan, pilot operation, burner operation.

- C. Provide fan discharge thermostat to control modulating gas valve to maintain supply air temperature.
- D. Provide safety controls with manual reset to provide correct air flow before energizing pilot and to sense pilot ignition activating main gas valve.
- E. Provide manual reset low and high limit controls to maintain supply air temperature between set points and shut fan down if temperatures are exceeded.
- F. Provide purge period timer to delay burner ignition and automatically bypass low limit control.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances, roof curb, and other conditions affecting performance of roof top unit.
- B. Examine rough-in for electrical to verify actual locations of connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Installation and connection of gas-fired heaters and associated fuel and vent features and systems installed and connected in accordance with NFPA 54, applicable local codes and regulations, and manufacturers printed installation instructions.
- B. Connect gas piping in accordance with Section 230140 "Natural Gas Systems." Connect gas piping with shut off valve and drip.
- C. Connect vents in accordance with Section 230890 "Breechings, Chimneys and Stacks."
- D. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.
- E. See Section 230020 for installation requirements.
- F. Field mounted temperature controls are to be provided under Section 230960. Coordinate factory installed controls in this section with Section 230960.
- G. Electrical Connections: The following requirements apply:
 - 1. Electrical power wiring is specified in Division 26.
 - 2. Temperature control wiring and interlock wiring is specified in specification section 230960, "Temperature Control System."
 - 3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.3 COMMISSIONING

- A. Test functions, operations, and control sequences and protective features. Adjust to assure operation is in accordance with design.
- B. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.4 CLEANING AND ADJUSTING

- A. Cleaning: Upon completion of installation, inspect heaters and associated components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.
- B. Adjusting: Make burner and other unit adjustments for optimum heating performance and efficiency. Adjust heat distribution features, including louvers, vanes, shutters, dampers, and reflectors, to provide optimum heat distribution for objects, personnel, and spaces served.

3.5 DEMONSTRATION

- A. Training: Demonstrate adjustment, operation, and maintenance of heaters and heater systems and train Owner's personnel.

END OF SECTION 230671

SECTION 230680 – ELECTRIC HEATING TERMINALS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the electric heating terminal installation indicated on the drawings and/or specified herein.
- B. Extent of electric heating terminal work is indicated by drawings and schedules and as specified herein. Types of units are as follows:
 - 1. Propeller Unit Heaters - Electric
 - 2. Wall Mounted Electric Heaters
 - 3. Fan-forced Ceiling Heater

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230960 - Temperature Controls.
- F. Refer to Division 26 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on terminal unit. Include disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Section 230000.
- B. Product Data: Submit manufacturer's product data indicating typical catalog of information including optional components, color selections & arrangements. Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.
- C. Submit manufacturer's installation instructions.
- D. Shop Drawings: Submit layout drawings of electric heating terminals and control units showing accurately scaled cross section of cabinets, views of cabinets, dimensional information, grille, bracing and reinforcing, and typical elevation.

- E. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
- F. Wiring Diagrams: Submit wiring diagrams for electrical heating terminals showing connections to electrical power feeders, and associated control wiring. Clearly differentiate between wiring which is manufacturer-installed and that which is field-installed.
- G. Wiring diagrams for electric duct heater shall include recommend supply wire gauges per NEC for all field wiring. Fuse sizes shall be indicated on wiring diagram. Typical wiring diagrams are not acceptable.
- H. Data for inclusion in Operating and Maintenance Manual specified in Section 230000.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of electric heating terminals of types, ratings, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.5 CODES AND STANDARDS

- A. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to construction and installation of electric heating terminals.
- B. UL Compliance: Provide electric heating terminals which are UL-listed and labeled.
- C. NEMA Compliance: Provide heating terminal accessories which comply with NEMA standards.
- D. NFPA Compliance: Comply with applicable requirements of NFPA 90A and B standards pertaining to construction and installation of duct heating coils.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver electric heating terminals in factory-fabricated type containers or wrappings, which properly protect terminals from damage.
- B. Store electric heating terminals in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, but store above grade and enclose with watertight wrapping.
- C. Handle electric heating terminals carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

- A. Manufacturers: selection has been based on Q-Mark to establish the desired style and quality. Products by the following manufacturers, complying with these specifications, are acceptable:

1. Federal Pacific Electric Co.
 2. Markel Nutone Div; Scoville, Inc.
 3. Trane
 4. Berko Chromalox Div, Emerson Electric Co.
 5. Indeeco
- B. Materials and Equipment: Except as otherwise indicated, provide electric propeller unit heater manufacturer's standard materials as required for a complete installation.
- C. Heating Elements:
1. General: Except as otherwise indicated, provide manufacturer's standard heating elements of types, sizes, capacities and ratings for duty indicated; consisting of resistance elements in steel sheath with extended fins, or with spirally finned sheath.
 2. Electric Heating Capacity: Size elements for indicated heating load, fan speed, CFM, entering air temperature, and electric input (watts, voltage, phase).
- D. Casings: Provide casings braced and reinforced to provide required stiffness, and with adjustable heating element supports and brackets. Provide rounded corners. Phosphatize and paint casings inside and out with single coat of baked-on enamel; and zinc plate hardware. Include fan orifice (venturi) in casing, as well as threaded hanger connections (weld nuts). Fabricate from 18-gage galvanized steel.
- E. Fans: General: Provide aluminum propeller fans which are balanced statically and dynamically, of indicated capacity. Provide fans suitable for standard or sparkproof application as indicated on Heating Terminal Schedule.
- F. Air Deflectors: Provide manufacturer's standard 2-way adjustable horizontal louvers.
- G. Motors:
1. General: Provide totally enclosed shaded-pole, or permanent-split capacitor motors with Class "B" insulation, resiliently mounted. Select motors with electrical characteristics as indicated on the drawings.
 2. Internal Electrical Wiring: Provide units with high temperature, heat-resistant electrical wiring enclosed in flexible metal conduit extending from terminal junction box to electrical devices. Provide fusing for motor and control circuit wiring.
- H. Accessories:
1. Thermally activated fan switch to keep fan motor operating until residual heat is dissipated.
 2. Disconnect switch.
 3. Automatic reset, high limit cut-out switch located in discharge air stream.
 4. Magnetic contractor.
 5. Control transformer.
 6. Wall-mounted thermostat.
- I. Electrical Power
1. Three phase units shall be fed with a 4 wire feeder.

2.2 FAN-FORCED CEILING HEATER

- A. Manufacturers: selection has been based on Q-Mark to establish the desired style and quality. Products by the following manufacturers, complying with these specifications, are acceptable:
 - 1. Brasch Mfg. Co.
 - 2. Trane
 - 3. Berko
 - 4. Markel
 - 5. Indeeco
- B. Fan-forced heater.
- C. Nichrome element.
- D. Surface mounting on any standard ceiling outlet box.
- E. White ceiling cover and maintenance free aluminum grille.
- F. Thermal cutout and internal cooling motor.
- G. Control with on-off wall thermostat.
- H. Heater and electrical accessories shall be labeled by Underwriters Laboratories, Inc.
- I. Capacity and Voltage: As indicated on drawings.
- J. Electrical Power
 - 1. Three phase units shall be fed with a 4 wire feeder.

2.3 WALL MOUNTED ELECTRIC HEATERS

- A. Manufacturers: selection has been based on Q-Mark to establish the desired style and quality. Products by the following manufacturers, complying with these specifications, are acceptable:
 - 1. Brasch Mfg. Co.
 - 2. Trane
 - 3. Berko
 - 4. Markel
 - 5. Indeeco
- B. Fan-forced heater, with fan delay.
- C. Heavy duty steel fins brazed to steel tubular elements in grid pattern which covers entire discharge area.
- D. Recessed in standard 2x4 or larger wall sections.
- E. Commercial grade steel grille creates downflow air pattern.
- F. Totally enclosed motor, impedance protected with permanently lubricated bearings.

- G. Built-in snap action thermostat.
- H. Heater and electrical accessories shall be labeled by Underwriters Laboratories, Inc.
- I. Neutral gray baked-on enamel finish.
- J. Furnish optional disconnect switch kit, for electrical to install.
- K. Electrical Power
 - 1. Three phase units shall be fed with a 4 wire feeder.

PART 3 - EXECUTION

- 3.1 Install electric heating terminal units and accessories in accordance with manufacturer's recommendations and with recognized industry practices. Comply with applicable installation requirements of NEC and NECA's "Standard of Installation".
- 3.2 Locate each unit accurately in the position indicated in relation to other work. Position work with sufficient clearance for normal service and maintenance, including clearance for cabinet removal.
- 3.3 Coordinate with the electric contractor for proper power requirements.
- 3.4 See Section 230960, Temperature Controls, for installation of thermostats and other controls.
- 3.5 Clean dust and debris from each heating terminal as it is installed to ensure cleanliness. Install filters before start and before store opening.
- 3.6 Touch-up scratched or marred heating terminal enclosure surfaces to match original finishes.
- 3.7 Provide equipment grounding connections for electric heating terminals as indicated.
- 3.8 Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A.
- 3.9 Testing: Upon completion of installation of electric heating terminals, and after building circuitry has been energized, test heating terminals to demonstrate capability and compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- 3.10 Units shall be controlled as indicated in Section 230960, Temperature Controls.

END SECTION 230680

SECTION 230702 - CONDENSING UNITS AND CONDENSERS**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Provide factory assembled and tested hermetic, reciprocating, helical or scroll air cooled condensing units and/or air cooled condensers as specified and scheduled on the drawings.

1.2 RELATED DOCUMENTS:

- A. All applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions
- C. Section 230010 - Basic Mechanical Materials and Methods
- D. Section 230020 - Vibration Isolation
- E. Section 230100 - Installation of Piping
- F. Section 230150 - Refrigerant Piping

1.3 REFERENCES:

- A. ANSI/UL 303 - Refrigeration and Air-Conditioning Condensing and Air-Source Heat Pump Equipment.
- B. ANSI/UL 465 - Central Cooling Air Conditioners.
- C. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- D. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.
- E. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- F. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.
- G. ASHRAE Compliance: Construct and install condensing units and condensers in accordance with ASHRAE Std 15-1994, "Safety Code for Mechanical Refrigeration."
- H. NEC Compliance: Comply with applicable National Electrical Code (NEC) requirements pertaining to electrical power and control wiring for construction and installation of condensing units and condensers.
- I. ANSI Compliance: Comply with ANSI B9.1 safety code requirements pertaining to unit construction of condensing units and condensers.
- J. ASME Compliance: Construct and test condensing units and condensers in accordance with ASME Boiler and Pressure Vessel Code, Section 8.

- K. UL Compliance: Comply with applicable requirements of UL 465, "Central Cooling Air Conditioners," pertaining to construction and installation of condensing units and condensers. Provide condensing units and condensers which are UL-listed and labeled.

1.4 SUBMITTALS:

- A. Provide submittals in accordance with Section 230000 - Mechanical General Conditions.
- B. Product Data: Submit manufacturer's technical product data, including rated capacities, indicated EERs, weights (shipping, installed, and operating), and furnished specialties and accessories; and rigging, installation, and start-up instructions.
- C. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components, and location and size of each field-connection.
- D. Provide templates for anchor bolt placement in concrete pad.
- E. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- F. Operation and Maintenance: Submit manufacturer's operation and maintenance data under provisions of Section 230000 - Mechanical General Conditions.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Hoist to the locations indicated on the plans where they shall be installed.
- B. Handle condensing units and condensers and components properly to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new. Comply with manufacturer's rigging and installation instructions for unloading and transporting condensing units and condensers to final location.
- C. Store condensing units and condensers and components in clean dry space. Protect from weather, dirt, fumes, water, construction debris, and physical damage. Storage temperatures for unit controls are not to exceed 105°F.

1.6 WARRANTY:

- A. Provide warranty under provision of Section 230000 - Mechanical General Conditions.

PART 2 - PRODUCTS**2.1 Condensing Unit and Condenser Manufacturers:**

- A. Selection has been based on the manufacturer scheduled to establish the desired type, performance and quality. Equal products, complying with these specifications, by the following manufacturers are equally acceptable:

- 1. Trane Company

2. Carrier Corporation
3. York International
4. Daikin

2.2 Air-cooled Condensing Units:

- A. General: Unit shall be a factory fabricated, assembled and tested unit, and shall include all safety and operating controls, wiring, piping, etc., assembled in such a manner that the only field connections required are refrigerant suction, refrigerant liquid, electrical power, and control connections.
- B. Condensing unit shall comply with the following standards:
 1. Ratings shall be in compliance with ARI 520.
 2. ANSI/ASHRAE 15 Safety Code.
 3. Wiring shall comply with the National Electrical Code.
 4. Unit shall be ETL or UL listed.
 5. ASME Boiler and Pressure Vessel Code.
- C. Casing: Casing shall make unit fully weatherproof for outdoor installation. Casing shall be fabricated from galvanized steel and shall have a factory applied baked enamel finish. All edges of the metal shall have the same finish to protect the material from rusting. Openings shall be provided for power and refrigerant connections. Panels shall be removable to provide access for servicing.
- D. Condenser coil shall be fabricated from minimum 0.20 inch thick copper tubes with mechanically bonded, minimum 0.008 inch thick aluminum fins. Coil shall be circuited for 12°F subcooling. Leak test coils with air under water at 450 PSIG air pressure.
 1. Provide hail guards to protect condenser coil fins.
- E. Condenser fans shall be vertical discharge, direct or belt driven propeller type. Each fan shall have a fan guard. Fan motors shall have inherent protection, shall be resiliently mounted, and shall have permanently lubricated bearings.
- F. Units 1 to 5 tons: Inverter compressor, hermetically sealed, with rubber vibration isolators.
 1. Single circuit with 1) Liquid line solenoid valve, 2) Filter dryer, 3) Moisture Indicating Liquid line sight glass, 4) Thermal expansion valves for remote cooler(s) or DX coil(s), and 5) suction and discharge valves.
 2. Motor: Reluctance DC Motor, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 3. Inverter Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
 4. Accumulator: Suction tube.
 5. Refrigerant Charge and oil: R-32
 6. Accessories:
 - a. Coastal Filter: Mesh screen to protect condenser coil from salt damage.
 - b. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.

- c. Low-voltage thermostat and subbase to control condensing unit and evaporator fan.
 - d. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
 - e. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
 - f. Winter start controls 0 deg F.
 - g. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
 - h. PE mounting base to provide a permanent foundation.
 - i. Precharged and insulated suction and liquid tubing.
 - j. Sound Hood: Wraps around sound attenuation cover for compressor.
 - k. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
- G. Control Panel: Provide an electronic, microprocessor control panel, factory-wired for single-point power connection. Control system shall be located in a weatherproof enclosure. Panel access doors shall key lock. Dead-front panels shall be provided on the line voltage side.
- 1. Provide the following controls for each compressor:
 - a. Oil pressure cutout.
 - b. Motor protection, including under voltage, over voltage, imbalance voltage, single phasing and voltage spikes.
 - c. Power controls.
 - d. Compressor starters (across the line) and relays.
 - e. Non-recycling compressor overload device.
 - f. Timer to prevent short cycling.
 - 2. Provide the following for each refrigerant circuit:
 - a. Low-pressure cutout.
 - b. High-pressure cutout.
 - 3. Provide the following for each unit:
 - a. Terminal strip.
 - b. Reset relay.
 - c. Condenser fan controls.
 - d. Pump down control to allow unit to pump down once and shut off without further cycling of the compressor.
 - e. Manual pump down switch.
 - f. System on-off switch.
 - g. Freezestat.
 - 4. Unit wiring shall include:
 - a. Field power connection and, control interlock terminals.
 - b. Starting contactors for the compressor and for each condenser fan. Compressors shall start unloaded.

- c. Control circuit transformer and fusing.
- d. Overload and short circuit protection of all circuits, solid state compressor overload protection in all three phases, and inherent condenser fan motor overload protection.
- e. Terminals for flow switch, freeze stat, and liquid line solenoid valves.
- f. Factory installed non-fused disconnect.

H. Condensing unit shall have a minimum EER rating of 10.0.

PART 3 - EXECUTION

3.1 Manufacturer's Supervision:

- A. Condensing unit manufacturer shall supervise start-up of condensing unit work, with factory trained technical service representative. Prepare manufacturer's written report of start-up, signed by representative. Coordinate with manufacturer to schedule service representative.
- B. Include leak testing, evacuation, dehydration, vacuum pumping, and charging in scope of supervision by manufacturer's representative.
- C. Include troubleshooting of the condensing unit and all components of the refrigerant system, both new and existing, until the system is operating satisfactorily.
- D. Include lubrication, including filling of reservoirs, and confirming that lubricant is of quantity and type recommended by manufacturer in scope of supervision by manufacturer's representative.

3.2 Training of Owner's Personnel:

- A. Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of condensing unit.
- B. Schedule training with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

3.3 Inspection:

- A. This contractor shall examine the area and conditions under which condensing unit(s) are to be installed and shall notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been.
- B. Carefully inspect the positioning of the condensing units to orient them as shown on the drawings; final positioning of the condensing unit is the responsibility of this contractor. If discrepancies exist between the drawings and the equipment delivered to the jobsite, report these discrepancies immediately to the Engineer and General Contractor. Also report any visual damage. Do not install such items prior to resolving said discrepancies with the Engineer.

3.4 Installation of Condensing Unit:

- A. General: Install condensing unit in accordance with manufacturer's written instructions. Install units plumb and level, firmly anchored in locations indicated; maintain manufacturer's recommended clearances. Position units as indicated on the plans.
- B. Install floor or ground mounted units on reinforced concrete pad. Install roof mounted units on structural steel or reinforced concrete pad as indicated. Install condensing unit with vibration isolators specified in Section 230020, Vibration Isolation and Seismic Restraints.
- C. Provide connections to refrigeration piping to evaporators. Refer to Section 230150. Provide flexible connections as indicated. Comply with ANSI/ASHRAE 15.
- D. Do not release any refrigerant to the atmosphere.
- E. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements. Do not proceed with equipment start-up until wiring installation is acceptable to manufacturer and equipment installer.
- F. Control: Furnish field-installed automatic temperature control requirements to Temperature Control Contractor. See Section 230960. Field-installed automatic temperature controls are to be installed by the Temperature Control Contractor.
- G. Paint damaged and abraded factory finish with touch up paint matching factory finish.
- H. Start up condensing unit, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's technical representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment and retest.
 - 1. Do not place condensing unit in sustained operation prior to initial balancing of mechanical systems interfacing with the condensing unit.
 - 2. Furnish sufficient refrigerant and dry nitrogen for pressure testing under manufacturer's supervision.
 - 3. Provide refrigerant needed to charge system and replace losses during installation.
 - 4. Include troubleshooting of the condensing unit and all components of the refrigerant system, both new and existing, until the system is operating satisfactorily.
 - 5. For condensing units that are to be connected to existing evaporators, verify that existing evaporators are operating satisfactorily. Adjust existing thermal expansion valves where these exist. If any deficiencies are found, provide a written report to the Engineer documenting these conditions.

END OF SECTION 230702

SECTION 230802 - VAV ROOFTOP UNITS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the Packaged Rooftop Unit installation indicated on the drawings and/or specified herein.
- B. Each unit shall be furnished with insulated casing, angled filter box, centrifugal fans, coils as scheduled, drain pan, motors, drives, belt guards, roof curb, and accessories as required.
- C. All rooftop units (both constant volume and variable volume) shall be by one manufacturer.

1.2 REFERENCES

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 210 - Unitary Air-Conditioning Equipment.
- C. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- D. ANSI/NFPA 70 National Electrical Code.
- E. ANSI/AMCA Standard 204-05 - "Balance Quality and Vibration Levels for Fans".

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Material and Methods
- D. Section 230900 - Air Distribution.
- E. Section 230960 - Temperature Controls.

1.4 QUALITY ASSURANCE

- A. All units shall be rated and certified as complete units in accordance with ARI Standard 210/240-2008 and shall bear the ARI seal. Cooling capacity ratings shall be based on ARI Standard 340/360-2008 requirements.
- B. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate electrical service and duct connections on shop drawings or product data.
- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

- E. Include calibration certification documentation of factory installed temperature, humidity, enthalpy and CO2 control sensors.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site and hoist in place.
- B. Protect units from physical damage.

1.7 WARRANTY

- A. Entire unit shall have a one year warranty as described in Section 230000. The compressor shall be warranted an additional four (4) years beyond the first year. The additional four years for the compressor shall be for parts only and shall not include labor.

PART 2 - PRODUCTS

2.1 VAV Rooftop Unit

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Trane
 - 2. Carrier
 - 3. York
 - 4. Aeon
 - 5. Daikin
- B. Rooftop unit shall be a factory designed, manufactured and tested unit complete with weatherproof enclosure, roof curb, direct expansion cooling, fan, filter, internal wiring, refrigerant piping and accessories, operating and safety controls.
- C. Cabinet:
 - 1. Unit shall be designed for outdoor, rooftop or ground mounting.
 - 2. Cabinet shall be weatherproofed and gasketed so that the unit is leak proof.
 - 3. Cabinet shall be constructed of minimum 18 gage galvanized steel with factory applied baked enamel finish.
 - 4. Gasketed, hinged panels shall be provided at locations that require periodic maintenance.
 - 5. The entire air stream shall be internally insulated with, or equal to, 1" thick, 1-1/2 pound/cubic feet density fiberglass. Insulation shall conform to the requirements of NFPA 90A.
 - 6. Units shall be provided with supply and return air openings arranged as indicated on the plans.
 - 7. Units shall be equipped with lifting lugs.
- D. Evaporator Section:

1. Direct expansion cooling coil constructed of copper tubes and mechanically bonded aluminum fins. Coil shall be tested and proven leak-tight at a minimum of 450 psig. Circuiting shall be intertwined.
2. Insulated drain pan constructed of stainless steel with welded corners and coated with a rust-inhibitive material. Extend drain line to outside of unit. Drain pan shall extend beyond the leaving side of the coil and underneath the cooling coil piping connections. The drain pan shall be sloped in conformance with ASHRAE STD 62-1989. Insulation shall prevent condensation on the underside of the pan with 95°F and 80% relative humidity environment.
3. Coil face velocity shall not exceed 500 fpm.

E. Supply Fan Section:

1. Fans shall be selected to provide the airflow and pressure specified.
2. Supply fans shall be double width, double inlet centrifugal type with either forward curved or airfoil blades mounted on common shaft with fixed pitch sheave. The fan rotors shall be statically and dynamically balanced on fan shaft. Balance fans in accordance with AMCA 204-05.
3. Fans shall discharge horizontally into extended roof top unit casing unless otherwise indicated on the plans.
4. Units shall have solid steel fan shafts mounted in heavy-duty 200,000 hour average life greasable ball bearings.
5. Drives shall be direct-driven, rated for 125% of motor horsepower.
6. Motors shall be mounted on an adjustable base.
7. Extend grease lines to a single, accessible location for re-lubrication.
8. Fans shall be internally isolated by mounting fan and motor on a steel base supported by rubber in shear vibration isolators. Base shall be galvanized steel or coated with corrosion resistant paint.
9. Unit manufacturer shall internally isolate, or provide sound control of all internal components of the unit in such a manner that the units can be installed as indicated on plans without objectionable sound level being transmitted to nearby spaces. This sound and vibration control shall include, but not necessarily be limited to, spring vibration isolators on the compressors, isolation on the refrigerant line connections to compressor, air stream internally lined with insulating sound absorbing media.

F. Heater Section:

1. Electric Heating Coil
 - a. Coils shall be open-coil electric duct heaters. Voltage, size and wattage shall be as scheduled.
 - b. Heaters shall have galvanized steel frame.
 - c. Coil terminals and nuts shall be made of stainless steel. Terminal insulators and bracket bushings shall be made of high-grade ceramic and securely positioned. Resistance wire shall be iron-free, 80% nickel and 20% chromium. Bracket supports for the resistance wire shall be reinforced with stiffening ribs and gussets dielectrically tested for 1000 volts plus twice the rated voltage, or 2000 volts, whichever is higher. Provide element supports with 4" on center spacing

maximum. Heaters shall be furnished with heavy-duty coils, derated to 25 watts/sq. in. of wire surface.

- d. Protection - A disc-type automatic reset thermal cutout, serviceable through terminal box, shall be furnished for primary protection. Heat limiters in power lines shall serve as secondary protection. Provide positive pressure air flow switch and linear cutout for each heater.
- e. Control panels shall incorporate fuse blocks and fuses for each 48 ampere circuit and terminal blocks.

2. Gas Burner:

- a. Capacity shall be as indicated on the drawings.
- b. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark ignition, flame sensing device, and automatic 100 percent shut-off pilot.
- c. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
- d. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- e. Gas Control: Provide UL approved gas control system with the roof top units.
- f. Unit shall have single point gas piping connection.

3. Heat Pump Heating

- a. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heat pump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.
- b. The refrigerant system shall have a pump-down cycle.

G. Filter Section:

- 1. Hinged panels to allow replacement of filters. Access shall be from side.
- 2. 2" Farr 30/30 filters or approved equal.

H. Economizer Section:

- 1. Fresh air, return air, and relief air dampers sized for 100% outside air.
- 2. Barometric relief dampers sized for 100% of flow for unit without relief fans. Relief opening shall have a birdscreen.
- 3. Weatherproofed fresh air intake with birdscreen.
- 4. Low leakage dampers with blade edge and jamb seals rated at maximum 1% leakage at 1" static pressure.

I. Refrigeration Section:

1. Refrigeration section shall consist of all refrigerant piping, valves, coils, compressors, controllers and all other safety and operating devices required for a complete system of refrigeration. Units shall be factory charged with refrigerant R-32 and oil. Refrigeration system shall include, but not necessarily be limited to the following:
2. Compressor: Hermetic or semi-hermetic helical or scroll type compressor(s), resiliently mounted with spring or rubber in shear vibration isolators. Compressors shall be maximum 3600 rev/min. Compressors shall include:
 - a. Motor overload protection.
 - b. Crankcase heater for each compressor.
 - c. Suction and discharge service valves and gage ports.
 - d. Provisions for charging and purging system.
 - e. Oil pressure failure switch.
 - f. Low suction pressure and high condensing pressure cutouts.
 - g. Filter drier.
 - h. Oil pump, oil filter, oil level sight glass, and oil charging valve.
 - i. Five minute timed off circuit shall delay compressor start.
 - j. Provide step capacity control by cycling compressors and/or staging electric unloaders.
 - k. Stage 1 compressor shall be a digital scroll type compressor.
3. Refrigerant Piping:
 - a. Refrigerant piping shall be completely factory installed, dehydrated, tested, and charged with full operating charge of refrigerant and oil. The pipe shall be hard drawn refrigeration copper tubing with refrigerant grade fittings and brazed joints.
 - b. Suction line shall be insulated to prevent sweating.
 - c. Provide vibration isolation on hot gas and suction lines. Isolation shall be either refrigerant type flexible connectors or piping connections arranged to absorb compressor vibrations without transmitting the vibrations or without failing due to continual vibration.
4. Refrigerant Specialties:
 - a. Thermostatic expansion valves with adjustable superheat setting and external equalizer for each direct expansion cooling coil.
 - b. Liquid line solenoid valve for pump down control.
 - c. Sight glasses and filter dryers on each refrigerant circuit.
5. Rooftop unit shall have minimum two (2) independent refrigeration circuits, piped so that one circuit can continue to operate if the other circuit is down.
6. Non-recycling compressor control.
7. Low ambient control to allow compressor operation as required by enthalpy economizer controls.

J. Condenser Section:

1. Heavy duty aluminum fins mechanically bonded to seamless copper tubes. Factory pressure test coil to 450 psig.
 2. Condenser fans shall be vertical discharge, direct or belt drive fans with steel blades, statically balanced, with fan guards and three phase motors. All parts of the condenser section including fans, fan shafts, drives, motors and all other devices subject to weather conditions shall be protected against corrosion.
 3. Motors shall be permanently lubricated, with build-in current and thermal overload protection in a weather tight casing.
 4. Subcooled condenser circuit, and if required for storage capacity on pump down control, an ASME liquid receiver. On pump down, liquid shall not occupy more than 80% of storage volume. Provide ASME pressure relief valves.
 5. Provide a guard over the condenser coils to protect them from hail damage.
- K. Operating Controls:
1. DDC microprocessor controls shall control all unit functions. Controls shall be installed in the main control panel. Controls shall be run tested at the factory. At a minimum, unit shall have a 16 key keypad, a 2 line by 40 character display. Controls shall function as standalone controls or as part of a building management system involving multiple units. The microprocessor's memory shall be non volatile EEPROM type requiring no battery or capacitive backup, while maintaining all data.
 2. Spring return damper motors to close fresh air damper on power failure.
 3. Outdoor thermostat to lock out mechanical cooling when outdoor air is below its setting.
 4. Discharge air sensor to control leaving air temperature. Provide differential enthalpy changeover for economizer.
 5. CO2 control to reset the minimum outdoor air flow when occupancy in the building is below the design value.
 6. Remote control panel with a 7-day clock and status lights. Clock shall sequence unit to day and night cycles as programmed. Each clock shall have a 5-hour bypass timer.
 7. Controls for warm-up cycle.
 8. See temperature control Section 230960 or 230965 for additional requirements.
 9. Provide a frost stat to determine frost buildup on coil and cycle fans on without refrigerant flow to defrost coil.
- L. Provide a MSTP BACnet card in the unit controls to interface with the building DDC control system.
1. Provide two-year minimum warranty for each card, including parts and labor.
- M. Electrical:
1. Each unit shall be wired and tested at the factory before shipment and shall comply with NEC requirements, applicable UL standards, and all applicable codes.
 2. All internal power and control wiring shall be provided. All wiring shall be number coded and all electrical components shall be labeled as indicated on the electrical wiring diagrams. All electrical components shall be UL recognized where applicable.
 3. Each unit shall have a 115 volt control circuit transformer, system service switch, and control circuit fuse(s).

4. The compressor, supply and relief/return fan motor branch circuits shall be individually fused. The compressors, supply and relief/return fan motors shall have contactors and external overload protection. Provide short circuit and overload protection of all internal power and control circuits and components. Provide all contactors, relays and motor starters.
5. Main control panel shall be of weatherproof construction with a deadfront cover over the main power circuit controls. A terminal block shall be provided for the main power connection and terminal boards shall be provided for the low voltage control wiring. Knockouts shall be provided in the bottom of the main control panel for field wiring entrance. Starters for compressors shall be factory installed and wired.
6. Units shall be designed to operate from a single three-phase power supply. Voltage shall be scheduled on the plans. All other voltage requirements shall be an internal part of the unit, and all required transformers, fuses, wiring, etc., shall be factory installed.
7. Provide main non-fused disconnect.
8. An electrical service entrance shall be provided which allows access to route all high and low voltage electrical wiring inside the curb, through the bottom of the outdoor section of the unit and into the control box.
9. Provide three phase voltage monitor to continuously monitor each of the three phases. Monitor shall protect unit from under and over voltage, voltage unbalance, phase loss and phase reversal. Under and over voltage shall trip at $\pm 10\%$ of nominal voltage and shall have automatic reset. Phase unbalance shall be adjustable between 2% and 10% with factory setting of 5% with automatic reset. Trip delay range shall be adjustable from 2 to 30 seconds with factory setting of 2 seconds. Severe unbalance shall trip in 0.25 to 2 seconds if the trip delay is set above 2 seconds. Phase reversal shall trip within 150 milliseconds, maximum and shall have automatic reset.
10. Provide an accessible 115 volt, single phase, 15 amp, GFI receptacle, which shall be powered from a transformer in the control panel and wired ahead of the main disconnect switch. See schedule for units with this option.

N. Curb:

1. Provide factory supplied roof curb, minimum 14 gauge zinc coated steel with supply and return air duct channels, insulated pans, 1-1/2-inch-thick rigid fiberglass insulation adhered to inside walls, built-in cant and mounting flange for flat roof decks and 2-inch wood nailer. Ship knocked down and provide instructions for assembly. The curb shall be minimum 14 inches high and shall include a 2 inch by 4 inch wood nailer. Gasketing shall be provided for field mounting between the unit base and the roof curb.
2. The roof curb shall provide perimeter support of the air handling portion of the unit and a cross-rail support under the condensing section or shall provide perimeter support of the entire unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances, roof curb, and other conditions affecting performance of roof top unit.
- B. Examine rough-in for electrical to verify actual locations of connections prior to installation.

- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Install all components that the manufacturer indicates must be field installed.
- B. Curbs shall be set on concrete pads (field verify insulation for each curb and rail). Install curbs level and plumb, in accordance with manufacturer's written instructions. Coordinate with other elements of the work.
- C. Mount units on concrete pads or steel mounting frame (by G.C.) providing watertight enclosure to protect ductwork. Install units' level. See details on plans.
- D. Duct installations and connections are specified in other Division 23 sections.
- E. Provide copper P-traps on RTU condensate drain connections. Primary condensate drains shall discharge to green space.
- F. Electrical Connections: The following requirements apply:
 - 1. Electrical power wiring is specified in Division 26.
 - 2. Temperature control wiring and interlock wiring is specified in Division 23 Section "Temperature Control Systems."
 - 3. Static pressure control for supply fan, remove from unit if factory mounted and re-locate where shown on the drawings. Co-ordinate with controls contractor.
 - 4. National Electrical Code.
- G. Rooftop Unit Installation, Testing, and Start-up
 - 1. Contractor shall supervise start-up of roof top unit work, with factory trained technical service representative. Prepare written report of installation, signed by representative.
 - 2. Include proper fan motor rotation, fan wheel free rotation, lubrication of moving parts, damper operation, leak testing, refrigerant (charge if required), vacuum pumping, and charging in scope of supervision by manufacturer's representative. Do not purge any refrigerant to atmosphere.
 - 3. Include lubrication, including filling of reservoirs, and confirming that lubricant is of quantity and type recommended by manufacturer.
 - 4. Paint damaged and abraded factory finish with touch-up paint matching factory finish.
 - 5. Start-up roof top unit, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damage or malfunctioning controls and equipment.
 - 6. Provide new filters before air balance (after final cleaning).

END OF SECTION 230802

SECTION 230810 - PACKAGED HEATING/COOLING UNITS**PART 1 - GENERAL****1.1 WORK INCLUDED:**

- A. Furnish all labor, services, material and related items necessary to complete the Packaged AC Unit installation indicated on the drawings and/or specified herein. Type of units specified in this section:

- 1. Split System Air Conditioners

1.2 RELATED DOCUMENTS:

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Material and Methods.
- D. Section 230020 - Vibration Isolators.
- E. Section 230960 - Temperature Controls.

1.3 REFERENCES:

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 210 - Unitary Air-Conditioning Equipment.
- C. ARI 240 - Air Source Unitary Heat Pump Equipment.
- D. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- E. ANSI/NFPA 70 National Electrical Code.
- F. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

1.4 QUALITY ASSURANCE:

- A. All units shall be rated and certified as complete units in accordance with ARI Standard 210/240-94 and shall bear the ARI seal. Cooling capacity ratings shall be based on ARI Standard 340/360-93 requirements.
- B. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.5 SUBMITTALS:

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate electrical service and duct connections on shop drawings or product data.
- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

- E. Include calibration certification documentation of factory installed temperature, humidity, and enthalpy control sensors.
- 1.6 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver products to site and hoist in place.
 - B. Protect units from physical damage.
- 1.7 WARRANTY:
 - A. Entire unit shall have a one year warranty as described in Section 230000. The compressor shall be warranted an additional four (4) years beyond the first year. The additional four years for the compressor shall be for parts only and shall not include labor.

PART 2 - PRODUCTS

- 2.1 SPLIT SYSTEM AIR CONDITIONER
 - A. Acceptable Manufacturers:
 - 1. Mitsubishi
 - 2. Sanyo
 - 3. Carrier
 - 4. Daikin
 - 5. Samsung
 - 6. LG
 - B. Units shall be a split system air conditioning system comprised of an evaporator unit and a condensing unit of the size and capacity shown on the equipment schedules.
 - C. Components shall be designed for compatibility and shall be rated in accordance with applicable ARI Standards.
 - D. Units shall contain a holding charge of R-32 refrigerant. Provided refrigerant tubing including insulation on the suction and liquid lines between the condensing unit and the evaporator.
 - E. Unit casing panels for evaporator and condensing units shall be of 22 gauge steel, cleaned, phosphated and coated with resin primer and baked enamel finish. Removable panels shall provide complete access for servicing compressors and electrical control.
 - F. Condensing Units:
 - 1. Direct expansion air cooled condensing units shall be of the type, number and configuration shown on the plans. Each unit shall be a complete factory package consisting of compressor, condensing coil, condenser fans and motors, casing and refrigeration and temperature controls.
 - 2. Compressor:
 - a. Compressor shall be serviceable hermetic type. Compressor shall contain crankcase heater, vibration isolators, and shall be located in a separate section from condenser fans and coil.

- b. Compressor shall be capable of starting and sustained operation in cooling mode to 40°F ambient when indoor unit is supplied without an economizer.
- 3. Refrigerant System Safety Controls: All compressors shall be provided with the following minimum protection:
 - a. Overcurrent
 - b. Over temperature
 - c. Short cycle with lock-out light on room thermostat
 - d. High pressure relief
 - e. Low pressure relief
 - f. Liquid slugging (suction line accumulator)
 - g. Loss of charge
- 4. Condenser coil shall have aluminum plate fins mechanically bonded to copper tubes, cleaned, dehydrated, leak tested at 150 psig and pressure tested at 450 psig.
- 5. Condenser Fans and Motors:
 - a. Fans shall be of the direct driven propeller type with steel wire safety guards and shall be balanced statically and dynamically.
 - b. Fan motors shall have inherent overcurrent and over temperature protection.
- G. Indoor Packaged Evaporator Unit:
 - 1. Evaporator unit shall be a packaged wall mounted air handler consisting of direct expansion evaporator coil, insulated condensate pan, refrigerant accessories, forward curved fans, motor and direct drive, insulated casing and washable filter.
 - 2. Coil shall be aluminum plate fins mechanically bonded to copper tubes, cleaned, dehydrated, leak tested and sealed at the factory.
 - 3. Fans and Motors:
 - a. Indoor blowers shall be forward curved multiple wheel centrifugal type capable of delivering the required CFM at the external static pressure specified in the equipment schedule.
 - b. All fans shall be direct driven.
- H. Refrigerant Piping:
 - 1. Copper Tubing to 7/8 inch OD: ANSI/ASTM B88, Type K, annealed.
 - 2. Fittings: ANSI/ASME B16.26 cast copper.
 - 3. Joints: Flared.
 - 4. Suction & Liquid Line Insulation: 1/2" thick closed cell rubber with flame spread rating less than 25 and smoke developed rating less than 50 in compliance with ASTM E 84 (NFPA 255) testing methods.
- I. Provide insulated casing and condensate drain pan. Insulation shall be sufficient to prevent condensation on the exterior of the casing or drain pan in a with 95°F and 80% relative humidity environment.
- J. Unit shall be controlled from a wall mounted thermostat. Supply thermostat with unit.

PART 3 - EXECUTION

- 3.1 Examine areas and conditions under which units are to be installed, notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- 3.2 Installation of Split System Air Conditioners
- A. Install indoor fan units, where indicated on drawings, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.
 - B. Connect refrigerant piping, ductwork and condensate drain line. Route condensate drain to nearest floor drain, or to outdoors as-indicated on drawings.
 - C. Provide vibration isolators in accordance with Section 230020.
 - D. Install condensing units, where indicated on drawings, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.
 - E. Condensing units shall be located on concrete pad as indicated on the plans.
 - F. Provide refrigerant piping of the sizes shown on the drawings in accordance with manufacturer's recommendations.
 - G. Charge per manufacturers specifications with R-32. Do NOT discharge any refrigerant to the atmosphere.
 - H. Insulate refrigerant piping. Paint all insulation exposed to sunlight.

END OF SECTION 230810

SECTION 230820 – COMPUTER ROOM AIR CONDITIONING UNITS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the Computer Room Air Conditioner Unit installation indicated on the drawings and/or specified herein.

1.2 REFERENCES

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 210 - Unitary Air-Conditioning Equipment.
- C. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- D. ANSI/NFPA 70 National Electrical Code.
- E. ANSI/ASME - Boilers and Pressure Vessels Code.
- F. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. ASHRAE 52.2 - Methods of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Material and Methods.
- D. Section 230020 - Vibration Isolators
- E. Section 230100 – Installation of Mechanical Piping.
- F. Section 230150 – Refrigerant Piping.
- G. Section 230960 - Temperature Controls.

1.4 QUALITY ASSURANCE

- A. All units shall be rated and certified as complete units in accordance with ARI Standard 210 and shall bear the ARI seal. Cooling capacity ratings shall be based on ARI Standard 340/360 requirements. Filters shall be rated in accordance with ASHRAE Standard 52.2
- B. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate water, drain, electrical, duct connections, and refrigeration rough-in connections on shop drawings or product data.

- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site and hoist in place.
- B. Protect units from physical damage.

1.7 WARRANTY

- A. Entire unit shall have a one year warranty as described in SECTION 230000.
- B. The compressor shall be warranted five (5) years from date of Substantial Completion.
- C. Warranty Period for Control Boards: Manufacturer's standard, but not less than 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Liebert
- B. Compu-Aire, Inc.
- C. Stulz

2.2 MANUFACTURED UNITS

- A. Provide packaged, air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans, filters, humidifier, controls.
- B. Assemble unit for up-flow air delivery, in draw-through or blow-through configuration.
- C. Capacity shall be as indicated on the schedule on the drawings.

2.3 CABINET AND FRAME

- A. Structural Frame: 10 gage welded steel suitably braced for rigidity, capable of supporting compressors and other mechanical equipment and fittings; welded tubular steel floor stand with adjustable legs and vibration isolation pads.
- B. Doors and Access Panels: 18 gauge galvanized steel with polyurethane gaskets, hinges to allow removal of panels, and concealed fastening devices. The main front panel shall have captive 1/4 turn fasteners.
- C. Insulation: Thermally and acoustically line cabinet interior with 1" thick, 1.5 lbs. density acoustic duct liner.
- D. Finish of Exterior Surfaces: Baked-on textured vinyl enamel; color to match computer equipment.

2.4 FILTER CHAMBER

- A. The filter chambers shall be an integral part of the system, located within the cabinet, serviceable from either end or from the front of the unit.
- B. The filters shall be 2" thick, extended media, pleated type rated MERV 8 based on ASHRAE 52.2. Max. 500 ft/min face velocity, 0.30 inch WG initial resistance, and 1.0 inch WG recommended final resistance.

2.5 FAN SECTION

- A. Double inlet, forward curved centrifugal fans, statically and dynamically balanced as a completed assembly to a maximum vibration level of two mils in any plane, on steel shaft with self-aligning grease lubricated ball bearings.
- B. Bearings shall be self-aligning, greaseable ball bearings. Provide type having a minimum life "Rating Life" (AFBMA L10) of 100,000, calculated in accordance with AFBMA Standard 9 for ball bearings.
- C. Provide high efficiency direct drive motor and EC fan.

2.6 STANDARD CONTROL PROCESSOR

- A. The control system shall be microprocessor based with two .43 inch high (min.), seven segment LED numerical displays to allow observation of room temperature and humidity and each settable function:
 - 1. Temperature Setpoint 65-85 degrees Fahrenheit
 - 2. Temperature Sensitivity 1 to 5 degrees Fahrenheit
 - 3. Humidity Setpoint 40-60% R.H.
 - 4. Humidity Sensitivity 1% to 10% R.H.
 - 5. Normal Operating Modes (Cooling, Dehumidification) shall be indicated by colored LEDs on the unit-mounted display panel.

2.7 MICROPROCESSOR CONTROL SYSTEM

- A. Logic Circuitry: Microprocessor shall continuously monitor operation of process cooling system; continuously digitally display room temperature and room relative humidity; sound alarm on system malfunction and simultaneously display problem. When more than one malfunction occurs, flash fault in sequence with room temperature, remember alarm even when malfunction cleared, and continue to flash fault until reset.
- B. Malfunctions: Power Loss, Loss of Air Flow, Clogged Air Filter, High Room Temperature, Low Room Temperature, High Humidity, Low Humidity, Smoke/Fire, Compressor No. 1 - Overload, Compressor No. 2 - Overload, Compressor No. 2 - Low Pressure, Compressor No. 2 - High Pressure, Water-Under-Floor, and Supply Fan Overload.
- C. Light Emitting Diodes Display: Control Power On, System On, Humidification, Dehumidification taking place, Compressor No. 2 operating, Heat or Reheat operating, Economy Cooling.

- D. Provide push buttons to STOP process cooling system, START process cooling system, SILENCE audible alarm, push-to-test LED indicators, and display room relative humidity.
- E. A MSTP BACnet communication interface with building automation system shall enable building automation system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building automation system.
- F. The communications protocol provided by the MSTP BACnet card shall conform to the standards defined by ASHRAE/ANSI SPC 135. At a minimum the MSTP BACnet card shall support Read/Write services of Analog and Binary objects of the BACnet standard. Physical transfer of data shall be via RS-232 communications as defined in the open standard, BACnet.

2.8 COMPRESSORIZED SYSTEMS

- A. Provide minimum two refrigeration circuits: Each refrigeration circuit shall include hot gas mufflers, liquid line filter dryers, refrigerant sight glass with moisture indicator adjustable, externally equalized expansion valves, and liquid line solenoid valves. Compressors shall be individually serviceable without dismantling other components.
- B. Compressors: The compressors shall be digital scroll type located in a separate compartment so they may be serviced during operation of the equipment. The compressor shall have a suction gas cooled motor, vibration isolators, internal motor thermal overloads and oil sight glass. Provide manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication, a maximum operating speed of 1750 RPM for reciprocating type and 3600 RPM for scroll type, oil strainer, crankcase sight glass, internal motor protection, low pressure switch, and a minimum EER of 11.4.
- C. DX Cooling Coil
 - 1. The evaporator coil shall be an A-Frame, direct expansion, refrigerant design and have a maximum face velocity of 500 feet per minute. It shall be constructed of copper tubes and aluminum fins.
 - 2. Refrigerant of each system shall be distributed throughout the entire coil face area.
 - 3. Provide minimum two refrigeration circuits, each with hot gas mufflers, thermal expansion valve with external equalizer, liquid line solenoid valve, liquid line filter-drier, refrigerant sight glass with moisture indicator, service shut-off valves and charging valves, accumulator sized for liquid seal under light load.
- D. Drain Pan shall be an insulated stainless steel condensate drain pan complying with ASHRAE 62.1-2004. Insulation shall prevent condensation on the underside of the pan with 95°F and 80% relative humidity environment.
- E. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tube aluminum-fin coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel and disconnect switch. Control capacity by cycling fans or modulating fan speeds.

2.9 OPTIONS

- A. Disconnect Switch (Non-Locking Type)
- B. The non-automatic molded case circuit breaker shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible with the door closed.
- C. For units 2,000 cfm or higher, provide a smoke detector in the return air stream to shut down the environmental control system when activated.
- D. Condensate Pump with capacity of 145 GPH at 20 ft. head. It shall be complete with integral float switch, pump and motor assembly, and reservoir.
- E. Liqui-Tect Sensors (Max. of two per unit).
- F. Provide solid state water sensors under the raised floor. Quantity as indicated on the plan or one per 100 sq. ft.
- G. Supply Air Turning Vane
- H. Condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

2.10 ELECTRICAL PANEL

- A. Service Connections, Wiring, and Disconnect Requirements: Conform to Section 16180.
- B. Control Cabinet: NEMA 250; Type 2 enclosure, UL listed, with piano hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer.
- C. Disconnect Switch: Non-automatic molded case circuit breaker with handle accessible with panel closed.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify that flooring system is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Comply with vibration isolation and seismic requirements of Section 230020.
- C. Install Air-Cooled Refrigerant Condenser using vibration isolation devices shown on the schedule. Comply with requirements for vibration isolation devices specified in Section 230020 "Vibration Controls for HVAC Piping and Equipment."

- D. Electrical Wiring: Install and connect electrical devices furnished by manufacturer, but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.
- E. Piping Connections: Install and connect devices furnished by manufacturer, but not specified to be factory mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

3.3 FIELD QUALITY CONTROL

- A. Start-up mainframe coolant units in accordance with manufacturer's start up instructions.
- B. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test controls and safeties and demonstrate compliance with requirements. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 230820

SECTION 230890 – BREECHINGS, CHIMNEY AND STACKS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, material and related items necessary to complete the HVAC heating system installation indicated on the drawings and/or specified herein.
- B. Extent of work required by this section is indicated on schedules, and by requirements of this section.

1.2 SECTION INCLUDES

- A. Manufactured chimneys for gas fired equipment.
- B. Breechings.
- C. Combustion air intakes for gas fired equipment.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Mechanical Basic Materials and Methods.
- D. Section 230020 - Vibration Isolation and Seismic Restraints.

1.4 REFERENCES

- A. ANSI/ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process, General Requirements.
- B. ANSI Z21.66 - Electrically Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- C. ANSI Z223.1 (NFPA 54) - The National Fuel Gas Code.
- D. ASHRAE - Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems."
- E. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
- F. ASTM D 1784 - Chlorinated PolyVinyl Chloride (CPVC) Pipe and Fittings
- G. ASTM D 1785 - Poly Vinyl Chloride Plastic Pipe, Schedules 40, 80, and 120
- H. ASTM D 2665 - PolyVinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

- I. ASTM D 2855/ ASTM D 2564 - Plastic Solvent Cement for PVC Plastic Pipe
- J. ASTM F 438 - Socket-Type Chlorinated PolyVinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40
- K. ASTM F 441 - Chlorinated PolyVinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80
- L. ASTM F 493 - Plastic Solvent Cement for CPVC Plastic Pipe.
- M. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel- Burning Appliances.
- N. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- O. UL 103 - Standard for Factory Built Low Heat Chimneys.
- P. UL 378 - Standard for Draft Equipment.
- Q. UL 441 - Standard for Gas Vents.
- R. UL 641 - Standard for Low Temperature Venting Systems.

1.5 DEFINITIONS

- A. Breeching: Vent Connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Smoke Pipe: Round, single wall vent connector.
- D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.6 Design Requirements: Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.**1.7 SUBMITTALS**

- A. Submit shop drawings, product data, and manufacturer's installation instructions data under provisions of Section 230000.
- B. Submit shop drawings indicating general construction, dimensions, weights, support and layout of breechings. Where factory built units are used submit layout Drawings indicating plan view and elevations.
- C. Submit product data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights.

1.8 Conform to applicable code for installation of natural gas burning appliances and equipment.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Selkirk Metalbestos
- B. American Metal Products
- C. Barron
- D. Schebler

2.2 INTAKE FOR HIGH EFFICIENCY UNIT HEATERS

- A. Poly-vinyl Chloride Pipe and Fittings: (except not allowed in ceiling plenums)
 - 1. PVC schedule 40 pipe with plain ends: ASTM D-2665.
 - 2. Socket fittings, schedule 40: ASTM D-2665.
 - 3. Solvent cement joints: ASTM D-2665.
- B. Chlorinated Poly-vinyl Chloride Pipe and Fittings:(except not allowed in ceiling plenums)
 - 1. CPVC schedule 40 pipe with plain ends: ASTM D-2665.
 - 2. Socket fittings, schedule 40: ASTM D-2665.
 - 3. Solvent cement joints: ASTM D-2665.D-2665.
- C. Chlorinated Poly-vinyl Chloride Pipe and Fittings:(for use in ceiling plenums)
 - 1. CPVC schedule 40 pipe with plain ends and fittings: Spears Lab Waste CPVC complying with ASTM D-1784 and ULC listed as equal to ASTM E-84 having a flame spread rating of less than 25 and a smoke developed rating of less than 50.
 - 2. Solvent cement: ASTM F-493.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and UL listing.
- B. Install in accordance with recommendations of ASHRAE - Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems," and ANSI Z223.1 (NFPA 54).
- C. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.
- D. Pitch vent connectors with positive slope of 1/4" per foot up from fuel-fired equipment to chimney or stack.
- E. Install vent dampers, locating close to draft hood collar, and secured to breeching.
- F. Level and plumb chimney and stacks.

- G. Clean connectors, breechings, chimneys, and stacks during installation, removing dust and debris.
- H. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of connectors, breechings, chimneys, or stacks.
- I. For PVC and CPVC intakes and vents, install Spears LabWaste CPVC where pipes pass through plenum rated ceilings.
- J. All air intakes shall be insulated with 2" fiberglass insulation. See section 230200.

3.2 CHIMNEY / STACK SCHEDULE

EQUIPMENT	CHIMNEY / STACK
Unit Heater (with Power Ventilator)	Positive Pressure Stack

3.3 Combustion Air Intake Schedule

EQUIPMENT	COMBUSTION AIR INTAKE
Unit Heater (with Power Ventilator)	PVC pipe or CPVC pipe for ceiling plenums

END OF SECTION 230890

SECTION 230900 – AIR DISTRIBUTION**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.
- B. Furnish all labor, services, material and related items necessary to complete the ductwork installation indicated on the drawings and specified herein.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Materials and Methods.
- D. Section 230020 - Vibration Isolation.
- E. Section 230200 - Mechanical Insulation - external duct insulation.
- F. Section 230930 - Testing and Balancing.
- G. Section 230960 - Temperature Controls - motorized dampers.
- H. Section 260721 - Fire Alarm System – Addressable, for smoke detectors.

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Latest edition shall apply unless otherwise indicated.
- B. AMCA 500 - Test Method and Louvers, Dampers and Shutters.
- C. ASTM A 36 - Carbon Structural Steel.
- D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- E. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.
- F. ASTM A 480 - General Requirements for Flat-Rolled Stainless Steel, Sheet and Strip.
- G. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- H. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- I. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- J. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
- K. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- L. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- M. AWS D9.1 - Welding of Sheet Metal.
- N. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- O. NFPA 96 - Installing of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- P. SMACNA -HVAC Air Duct Leakage Test Manual, 1st Edition.
- Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible. (2005 Third Edition) (subsequently referenced as "SMACNA 2005").

- R. UL 33 - Standard for Safety Heat Responsive Links for Fire Protection Service.
- S. UL 181 - Standard for Safety Factory-Made Air Ducts and Connectors.
- T. UL 555 - Standard for Fire Dampers.
- U. UL 555S - Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.
- V. UL 2043 - Fire test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Section 230000.
- B. Product data including materials, details of construction, dimensions of individual components, profiles, manufacturer's installation instructions, and finishes for the following items:
 - 1. Air Devices: Submit schedule of outlets and inlets indicating type, size, accessories, finish/color, type of mounting, air performance, static pressure drop, throw, and noise level.
 - 2. Duct Liner
 - 3. Sealant and Gasket Materials
 - 4. Fire-Stopping Materials
 - 5. Flexible ducts and clamps, with manufacturer's installation instructions
 - 6. Flexible Connectors
 - 7. Fire Dampers and Sleeves
 - 8. Backdraft Dampers
 - 9. Balance Dampers
 - 10. Access Doors
 - 11. Louvers
- C. Proposed deviations of materials and methods from these specifications require approved submittal information prior to any construction. Submittals should clearly note that the submittals is for a change to the specifications and identify the applicable paragraph from this specification. Submittals shall include physical descriptions and results of testing and analysis to support the equal performance of the substituted items. Testing and analysis shall follow the guidelines for "Functional Criteria" from SMACNA standards.
- D. Record drawings indicating duct actual routing in accordance with Section 230000.
- E. Duct leakage testing confirming compliance with tests required for ducts over 2 inches WG pressure class.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA 2005 - HVAC Duct Construction Standards - Metal and Flexible.
- B. Manufacturer Qualifications: Company specializing in manufacturing Products specified with minimum 5 years documented experience.

- C. Installer Qualifications: Company specializing in performing the Work of this Section with minimum 5 years documented experience.
- D. Regulatory Requirements: Construct ductwork to NFPA 90A and NFPA 96 standards.
- E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests:
 - 1. All ducts over 2 inches WG pressure class shall meet requirements of seal class A in Section 1 of SMACNA HVAC Air Duct Leakage Test Manual.
 - 2. All ducts 2 inches w.g. pressure class or less shall meet requirements of seal class C.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.
- B. Protect dampers from damage to operating linkages and blades.
- C. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- D. Store and handle sealant and fire-stopping materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 Sheet metal work as shown on plans is schematic and is based on the specified manufacturer's equipment and material dimensions. Contractor shall make accurate measurements in the field prior to duct work fabrication and shall provide all necessary offsets and transition pieces required to accommodate actual structural and equipment variations.

1.8 The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing to the Engineer.

1.9 At contractor's option, round duct may be substituted for rectangular construction and vice versa. Equivalent round duct sizes shall be in accordance with ASHRAE Fundamentals 2009, Chapter 21, Table 2. Contractor shall be responsible for coordination with other trades and any subsequent costs incurred by others for substituting round and rectangular ductwork.

1.10 Rectangular duct dimensions are sheet metal dimensions. For those ducts with internal liner, the duct dimensions include the liner.

1.11 Round duct dimensions are inside, free area dimensions.

1.12 The work shall be coordinated with that of other trades in such a manner that when the installation is complete, all items are properly installed and are serviceable.

1.13 Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

- A. Supply Ducts for non VAV systems: 2 inches water gauge.

- B. Supply Ducts between supply fan and VAV boxes: 4 inches water gauge.
- C. Supply Ducts downstream of VAV boxes: 2 inches water gauge.
- D. Return and Relief Ducts: 2 inch water gauge, negative pressure.
- E. Outside Air Ducts: 2 inch water gauge, negative pressure.
- F. Supply Ducts from Energy Recovery Units: 2 inch water gauge, positive or negative pressure.
- G. Exhaust Ducts on Suction Side of an Exhaust Fan: 2 inches water gauge, negative pressure.
- H. Exhaust Ducts on Discharge of an Exhaust Fan to building exterior: 2 inch water gauge.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Supply, return, outside air, and relief air ductwork for HVAC systems, Exhaust ductwork (except where otherwise indicated below), and Supply ductwork to kitchen hood systems shall be constructed of:
 - 1. Galvanized Sheet Steel, ASTM A 653, Lock-Forming Quality, Coating Designation G 90.
 - 2. Provide mill phosphatized finish for ducts exposed to view that are to be painted.
 - 3. Reinforcement, Support, Hanger, and Trapeze Shapes and Plates:
 - a. ASTM A 36/A 36M, steel plates, shapes, and bars. Unless otherwise indicated, provide galvanized finish of fabricated plates, shapes, and bars or provide fabricated plates, shapes, and bars of the same material as the sheet metal ducts.
 - b. Strut-Channels: Duct reinforcements, supports, and trapeze hangers may alternatively be a bolted metal framing system equal to B-Line. The system shall be channels, fittings and hardware as defined and tested in accordance with the Metal Framing Manufacturers Association Standard Publication MFMA.
 - 1) Channels shall be electrogalvanized zinc coated and made from steel meeting ASTM A570, Grade 33. Hot dip galvanizing after fabrication shall be in accordance with ASTM A123.
 - c. Where the galvanic index of the reinforcements, supports, hangers, or trapeze and the duct materials is greater than 0.15 volts (galvanized-steel plates, shapes, bars, or struts are used to reinforce aluminum or stainless steel ducts), isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- B. Exhaust Ductwork for Residential Kitchen Hoods shall be constructed of:
 - 1. Stainless Sheet Steel, ASTM A167, Type 304 or Type 316
Or
 - 2. Aluminum Sheet, ASTM B 209, alloys 1100, 3003 or 5052.
- C. All materials used shall meet the requirements of NFPA 90A and UL 181 for Class I air ductwork.
- D. Minimum Sheet Metal Gauges for Ductwork:

1. Rectangular ductwork shall be fabricated from the following minimum thicknesses, regardless of duct construction methods, at 2 inch w.g. pressure class, for sizes indicated:

Max. Long Side Dimension	Steel Gauge
0-12 inches	26
13-16 inches	24
17-18 inches	22
19-20 inches	20
21-30 inches	18
31 inches and above	16

2. Round ductwork shall be fabricated from the following minimum gauges for sizes indicated: (Round ductwork shall not be allowed for ducts over 84".)

Duct Diameter	Steel Gauge
Under 14 inches	28
15-18 inches	26
20-24 inches	24
26-42 inches	22
44-60 inches	20
62-84 inches	18

3. Minimum gauges for stainless steel shall be the same as listed for steel.
4. Minimum thickness and reinforcement for aluminum shall be as indicated in SMACNA 2005 Table 2-50, 2-51 and 2-52 for rectangular - ducts and 3-14, 2-51, and 2-52 for round ducts.

E. Sealants:

1. Joint and Seam Sealant: 3M-900 sealer.
2. Flanged Joint Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer. Rated per ASTM E-84 with maximum flame spread and smoke developed ratings of 10. Ductmate 5511M for attaching flanges to ducts, Ductmate 440 tape for flange to flange joints, or approved equal.
3. Isolation Gaskets: Butyl rubber, neoprene, silicone rubber, or EPDM polymer with polyisobutylene plasticizer. Rated per ASTM E-84 with maximum flame spread and smoke developed ratings of 10.
4. Slip On Flange Joint Mastic: Non-drying, non-skinning, polymer base, pumpable sealant. ASTM E-84 with maximum flame spread and smoke developed ratings of 5. Ductmate 5511M for attaching slip on flanges to ducts or approved equal.
5. Fire-Resistant Sealants for filling openings around duct penetrations through walls and floors shall be as specified in Section 230010, Basic Mechanical Materials and Methods.
6. General Sealant: One-part, acid-curing, Silicone, elastomeric joint sealant, complying with ASTM C 920, Type S (single component), Grade NS (nonsag), Class 25, Use O. Provide one of the following:
 - a. Chem-Calk 1200; Bostik Inc.
 - b. 999-A; Dow Corning.

- c. Construction 1200 or Contractors SCS1000 or SCS1702F; GE Silicones.
- d. HiFlex 392 or NuFlex 302; NUCO Industries, Inc.
- e. HM 270; Ohio Sealants, Inc.
- f. 860 or 863; Pecora Corporation.
- g. Tremsil 300; Tremco.

F. Acoustical Joint Sealants:

1. Applications: Seal joints in drywall sound enclosures as indicated on the sound enclosure details.
2. Acoustical Sealant for Exposed and Concealed Joints: Provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product shall effectively reduce airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Products: Provide one of the following:
 - a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
 - b. BA-98; Pecora Corporation.
3. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission. Provide one of the following:
 - a. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.
 - b. Pro-Series SC-170 Rubber Base Sound Sealant; Ohio Sealants, Inc.
 - c. Tremco Acoustical Sealant; Tremco.

2.2 SINGLE WALL RECTANGULAR DUCT FABRICATION

- A. Fabricate rectangular ducts in accordance with SMACNA 2005 Tables 2-1 through 2-48, including their associated details, and the Model Specifications shown in SMACNA 2005, except where this specification requires otherwise. Conform to the requirements in the referenced standard for metal thickness (except comply with minimum gages show above), reinforcing types and intervals, tie rod applications, and joint types and intervals.
- B. All reinforcements between transverse joints for duct dimension greater than 36 inches shall extend past the edge of the duct and be secured with an approved tie rod or tie angle as generally shown in SMACNA 2005 Figure 2-12 for "tie alternatives for two side reinforcements".
- C. All longitudinal seams shall be made with a Pittsburgh lock or a grooved seam. Fabricate transverse joints for all ducts with height or width 48 inches or greater with T-24, T-25, or Ductmate duct connections (or approved equal).
- D. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

- E. Where Ductmate (or equal) joints are used, they shall be rated as reinforcing class "F" for Ductmate 25, reinforcing class "G" for Ductmate 35, or reinforcing class "H" for Ductmate 45 and integrated with the requirements of SMACNA Tables 2-1 through 2-28. Similar tables from Ductmate Industries shall not be substituted for the SMACNA 2005 tables. Ductmate joints shall be installed in compliance with the manufacturer's recommendations.
- F. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- G. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA 2005 Figure 2-9, unless they are lined or are externally insulated.
- H. Tie Rods:
 - 1. Internal tie rods shall be allowed for ducts 36" wide and wider. Midpanel tie rods shall be allowed for ducts 36" wide through 96" wide.
 - a. Internal tie rods and midpanel ties shall not be allowed:
 - 1) Within 20 feet of a fan discharge or fan inlet.
 - 2) In kitchen hood exhaust ducts.
 - 3) In Fume exhaust ducts.
 - 4) In underground, in-slab, or under slab ducts.
 - 5) In fittings with non-parallel sides unless they have load distributing means such as wedges.
 - 6) In ducts with duct liner.
 - 7) For oval ducts, aluminum ducts or polyvinyl coated steel ducts, unless otherwise noted on the drawings.
 - 2. The maximum internal tie rod diameter shall be 3/4"; straps used for tie rods shall be maximum 1/8" thick and shall be installed with the thickness facing the air flow; angles or other structural shapes shall not be used for internal tie rods. Tie rods shall be attached to ducts in accordance with SMACNA 2005, Figures 2-5 and 2-6.
 - 3. Threaded inserts placed in pipes, tubes and conduits shall be secure for 200% of the loads indicated in SMACNA 2005, Table 2-34.
 - 4. Where internal ties occur in two directions, they shall be either prevented from contacting or be permanently fastened together.
- I. Singular Wall Rectangular Duct Fittings:
 - 1. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA 2005 Figures 4-1 through 4-9 and 7-1 through 7-4.
 - 2. All rectangular duct elbows shall be radiused in accordance with SMACNA Figure 4.2 type RE-1 (centerline radius equal to 1.5 x W) unless otherwise indicated.
 - a. Other Fitting Types:

- 1) Provide radius elbows with vanes, Figure 4.2 Type RE-3, where indicated and in accordance with details shown; minimum inner radius shall be equal to $0.5 \times W$ unless otherwise shown; two (2) or three (3) internal vanes shall be provided as indicated on the drawings per Figure 4-9 and spaced per Chart 4-1.
- 2) Rectangular square throat duct elbows shall be provided only where indicated and shall:
 - a) Provide single thickness, 4.5" radius turning vanes for vane lengths up to 36 inches and double thickness, 4.5" radius turning vanes for vane lengths over 36 inches, in accordance with SMACNA Figure 4-2 Type RE-2 and Figure 4.3. Spot weld vanes to end runners and screw runners to elbow cheeks with screws on 8 inch centers. Support vanes per SMACNA Figure 4-4.

2.3 SINGLE WALL ROUND DUCT FABRICATION

- A. Round ductwork shall be spiral lockseam construction as detailed in Fig. 3-1 of SMACNA 2005, unless otherwise indicated, and shall comply with minimum gauges indicated above and be reinforced per SMACNA 2005 Tables 3-5 through 3-13 for the pressure ratings indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Linx Industries (formally Lindab USA)
 2. McGill AirFlow LLC.
 3. SEMCO Incorporated.
 4. an approved local fabricator.
- C. Except where interrupted by fittings, provide round ducts in lengths not less than 12 feet.
- D. Transverse joints shall be beaded sleeve joints (type RT-1) as detailed in Fig. 3-1 of SMACNA 2005; vanstone flanges (type RT-2); welded, companion angle flanges (type RT-2A); or slip on flanges.
 1. Type RT-1 joints shall be secured with sheet metal screws as described in Fig. 3-1. Seal with joint and seam sealant.
 2. Type RT-2 joints (vanstone angles) shall have a minimum 3/8" flange on the duct with a continuous, rolled, back up angle. Provide a 3/16" thick Flanged Joint Gasket between the flanges.
 3. Type RT-2A joints (companion angle) shall have a continuous weld at the end juncture of the duct and the flange and shall have tack welds on 8" centers at the back leg of the angle flange. Provide a 3/16" thick Flanged Joint Gasket between the flanges.
 4. Slip on flanges shall be Ductmate Econoflange, Semco Accuflange, or approved equal and shall only be used with their ratings. Provide a 3/16" thick Flanged Joint Gasket between the flanges and apply Slip on Flange Joint Mastic.
- E. Attach reinforcing angles as detailed in Fig. 3-1-RT-2A of SMACNA 2005. Reinforcing rings and companion flange joints shall be as indicated in Tables 3-2, 3-3, and 3-4.

- F. Branch connections shall be made with 90° conical and 45° straight taps as shown on the drawings. All branch connections for new ducts shall be made as a separate fitting; saddle taps may be used for fittings that are added to existing ducts.
1. Where saddle taps are installed on existing ducts, the opening in the main duct shall closely match the saddle tap inlet opening. The entrance to the saddle tap shall have no excess material projecting into branch tap entrance. No burrs or rough welds will be allowed.
 2. The saddle tap shall be attached to the main duct with welds or screws on 3" centers maximum and the joint shall be sealed.
- G. Runouts to Air Devices:
1. In lieu of spiral lockseam construction, runouts may be fabricated with snaplock longitudinal joints (type RL-8) as detailed in Fig. 3-1 of SMACNA 2005. Transverse joints shall be either beaded sleeve joints (type RT-1) or crimp joints (type RT-5) as detailed in Fig. 3-1 and secured with sheet metal screws as indicated in the SMACNA details.
 2. Elbows for Runouts to Air Devices: Adjustable (Gored) Elbows may be used for supply ducts only at maximum 2 inch pressure class, minimum 4 piece construction, and maximum 18" diameter.
 3. Seal all joints. Fabricate with minimum 24 gauge galvanized steel.
- H. Round Duct Fitting Fabrication:
1. Ductwork and fittings shall be by the same manufacturer.
 2. Circumferential and longitudinal seams of all fittings shall be a continuous weld or spot welded and sealed with mastic. All welds shall be painted to prevent corrosion.
 3. 90-degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA 2005 Figures 3-5 and 3-6 and with metal thicknesses specified for longitudinal seam straight duct. Where bullhead tees are provided, they shall be Semco type BHT, BHT-1R, or BHT-2R with turning vanes or approved equal.
 4. Diverging-Flow Fittings: Fabricate with entrance to branch taps with no excess material projecting from the body onto branch tap entrance. No burrs or rough welds will be allowed.
 5. Elbows: Fabricate with die-formed, pleated, segmented (welded) or adjustable gore construction. Fabricate the bend radius of die-formed, segmented and pleated elbows 1.5 times the elbow diameter. Fabricate the bend radius of adjustable gore elbows 1.0 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements.
 - a. Segmented Elbows:
 - 1) Fabricate mitered elbows with continuous welded construction in gauges specified below.
 - 2) Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA 2005 Table 3-1.
 - 3) Elbows - Gauges: Provide minimum metal thickness listed below for duct size at pressure classes shown:

Duct size

Pressure Class Range Size

	-2 to 2"	2" to 10"
3 to 14 inches	24 gauge	24 gauge
15 to 26 inches	24 gauge	22 gauge
27 to 36 inches	22 gauge	20 gauge
37 to 50 inches	20 gauge	20 gauge
52 to 60 inches	18 gauge	18 gauge
62 to 84 inches	16 gauge	16 gauge

- b. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with single-thickness turning vanes. Equal to Semco model 902V. Elbows shall have a minimum number of vanes in accordance with the following:

Duct Diameter	Number of Vanes
3" thru 9"	2
10" thru 20"	3
21" and up	5

- c. For supply duct runouts to air devices only at maximum 2 inch pressure class, 24 gauge galvanized steel, Adjustable (Gored) Elbows with minimum 4 piece construction, and maximum 18" diameter may be used. Seal all joints.
- d. For Pressure Class above 2 inch.
- 1) Round Elbows - 8 Inches and smaller shall be die-formed elbows for 45-and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3½ and 4½ inch) elbows with segmented construction. Die-Formed Elbows shall be 20 gauge with 2-piece continuous welded construction. Pleated Elbows shall be 26 gauge.
 - 2) Round Elbows - 9 Through 14 Inches shall be segmented or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a 2 piece mitered elbow. Fabricate nonstandard bend angle configurations or ½ inch-diameter (e.g. 9½ and 10½ inch) elbows with gored construction. Pleated Elbows shall be 26 gauge. Segmented elbows shall be as indicated in the next paragraph.
 - 3) Round Elbows - 9 inches and Larger shall be segmented elbows with continuous welded construction, except where space restrictions require a 2 piece mitered elbow.
6. Couplings: Slip-joint construction per SMACNA 2005 Figure 3-2, detail RT-1 with a minimum of a 2-inch insertion length.
7. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
- a. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.
 - b. Round Elbows 9 to 26 Inches in Diameter: Standing seam construction.

- c. Round Elbows 28 to 60 Inches in Diameter: Standard gore construction riveted and bonded.
- d. Other Fittings: Riveted and bonded joints.
- e. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials and local authority having jurisdiction.
 - 1. Powder actuated fasteners shall not be allowed where the piping, ductwork or equipment is required to meet seismic bracing requirements in Section 230020 or the Building Code and unless the powder actuated fasteners are rated for these seismic loads. Powder actuated fasteners shall not be allowed in tension applications for Seismic Design Category D, E or F (as defined by the International Building Code).
 - 2. Do not use powder actuated concrete fasteners unless approved by the Engineer in writing.
- B. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69 except as modified herein.
- C. Upper attachments shall be as indicated in SMACNA 2005 Figures 5-1 through 5-4.
 - 1. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 - 2. Structural Attachments shall be B-Line, Unistrut, Grinnel, or approved equal:

Beam clamps:	B 3031, B 3033, B 3034, B 3050, B 3045
Angle Iron Beam Clamp:	B 3046
Bar Joist:	B 3059
Concrete Inserts:	B 3500, B 2505 thru 2508, or B 3014
Drilled Inserts:	Phillips Red-head, wedge anchors or equal.
- D. Hangers:
 - 1. Strap and band hangers shall be fabricated of the same material as the sheet metal ducts.
 - 2. Hanger sizes shall be as indicated in SMACNA 2005 Tables 5-1 and 5-2 for sheet steel width and gauge and steel rod diameters.
 - 3. Rod hangers shall be fabricated of round, cadmium-plated threaded steel rods and nuts.
 - a. Rod hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - b. Hanger rods shall be threaded both ends, threaded one end, or continuously threaded.
 - 4. Seismic sway bracing shall be in accordance with Section 230020.
 - a. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- b. Steel Cables for Stainless-Steel or Aluminum Ducts: Stainless steel complying with ASTM A 492.
 - c. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Lower Attachments:
 - 1. Duct attachments shall be sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
 - 2. Lower attachment shall be as indicated in SMACNA 2005 Figure 5-5.
- F. Trapeze and Riser Supports:
 - 1. Trapeze sizes shall be as indicated in SMACNA 2005 Tables 5-3 and 5-4 and Figure 5-6 and 5-8 through 5-10.
 - 2. Where trapeze or riser supports are a different material than the sheet metal duct, a minimum 1/16 inch thick isolation gasket shall be provided between the duct and the support.

2.5 FLEXIBLE ROUND DUCT

- A. Low Pressure Flexible duct shall be UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire coated to prevent corrosion; fiberglass insulation; and fiberglass reinforced aluminized vapor-barrier film and shall be used for systems up to 2" static pressure class.
 - 1. Insulated, Flexible Duct: round duct shall be Thermaflex M-KM or by Flexmaster, Flexible Technologies, ATCO, or Quietflex.
 - 2. Factory installed insulation shall be min. 3/4 pound density 2" thick, minimum R-6.0.
 - 3. Exterior vapor barrier shall have maximum vapor barrier permeance of 0.05 perm per ASTM Method E96, Procedure A
 - 4. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 - 5. Rated Air Velocity (or higher): 4000 fpm.
 - 6. Temperature Range: Minus 20 to plus 175 deg F.
- B. High Pressure Flexible duct shall be UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire coated to prevent corrosion; fiberglass insulation; and fiberglass reinforced aluminized vapor-barrier film and shall be used for systems from 2" to 10" static pressure class.
 - 1. Insulated, Flexible Duct: round duct shall be Thermaflex M-KC or by Flexmaster, Flexible Technologies, ATCO, or Quietflex.
 - 2. Factory installed insulation shall be min. 3/4 pound density 2" thick, minimum R-6.0.
 - 3. Exterior vapor barrier shall have maximum vapor barrier permeance of 0.05 perm per ASTM Method E96, Procedure A
 - 4. Pressure Rating: 10-inch wg positive and 1.0 inch wg negative.
 - 5. Rated Air Velocity (or higher): 5500 fpm.
 - 6. Temperature Range: Minus 20 to plus 250 deg F.

2.6 FLEXIBLE CONNECTORS

- A. Flexible connectors installed inside the building shall be heavy glass fabric, double coated with neoprene, of approximately 30 oz. per square yard, provided with 3" wide, 24 ga. metal mounting strips firmly attached to each edge. Connectors shall be suitable for pressure class of the air handling system. Flexible connectors shall be "Ventfab" by Ventfabrics, Inc. or equal.
- B. Flexible connectors installed outside the building shall be heavy glass fabric, double coated with neoprene, of approximately 26 oz. per square yard, provided with 3" wide, 24 ga. metal mounting strips firmly attached to each edge. Connectors shall be suitable for pressure class of the air handling system. Flexible connectors shall be Ventlong Hypalon by Ventfabrics, Inc. or equal.

2.7 DUCT LINER

- A. Fiber Glass Duct Liner shall comply with ASTM C 1071, NAIMA AH124, "Fibrous Glass Duct Liner Standard, and NFPA Standard 90A.
- B. Materials: ASTM C 1071, Type I, with an anti-microbial, coated surface exposed to airstream to prevent erosion of glass fibers.
- C. Thickness & Density: See Shop Application of Liner in Rectangular Ducts under Part 3 below.

Normal		
Thickness,	Density	
in.	pcf	R-Value*
1/2	1.5	2.2
1	1.5	4.2
1-1/2	1.5	6.0
2	1.5	8.0
1-1/2	3.0	6.5
2	3.0	8.7

- D. Thermal Performance: Provide minimum "R-Value" indicated above, at a mean temperature of 75°F.
- E. Liner, including coatings and adhesives shall have a flame spread of 25 or less and a smoke developed rating of 50 or less as determined in accordance with ASTM Standard E84.
- F. Liner Adhesive shall be a water-based adhesive complying with NFPA 90A or NFPA 90B and with ASTM C 916. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Operational temperature range -20 to +160°F; curing time 24 hours. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 1. Adhesive shall be Benjamin Foster 85-60, United McGill, type Uni-Tack or approved equal.

- G. All exposed edges and the leading edge of all cross joints of the liner shall be sealed to prevent glass fibers from separating and entering the airstream. Sealer shall be Benjamin Foster 30-36 or approved equal.
- H. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
1. Fastener Pin Length: As required for thickness of insulation, and without projecting more than $\frac{1}{8}$ inch into the airstream.
 2. Adhesive for Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.
- I. The duct liner shall have a surface roughness that gives an Air Friction Correction Factor not greater than 1.2 at velocities of 4000 FPM.
- J. The liner shall have the following Noise Reduction Coefficients Frequency:
- | Frequency | Coefficient |
|-----------|-------------|
| 125 | .23 |
| 250 | .54 |
| 500 | .68 |
- K. The duct liner shall Owens Fiberglass Quiet R Rotary Duct Board or equal by Knauff, Manville, Certain Teed or equal.

2.8 External Duct Insulation: See Section 230200 - Mechanical Insulation.

2.9 AIR DEVICES

- A. Model numbers for air devices are given in the Air Device Schedule. The model numbers and manufacturers listed are given to establish the desired style, quality, and performance. Products by the following manufacturers, equal to those scheduled and complying with these specifications, are equally acceptable.
1. Titus
 2. Krueger
 3. Nailor
 4. Price
 5. Tuttle & Bailey
 6. Metal Aire
- B. Diffuser and return air grille sizes given on the plans are neck sizes. Grille sizes are core sizes.
- C. Air devices shall have an NC rating of NC30 or less at specified CFM.
- D. Air devices shall be sized to match the ceiling grid. Furnish air devices for either regular grid ceilings or for narrow grid ceilings or for both types of grid; coordinate with the architectural reflected ceiling plans.

- E. Air device finishes shall be as follows:
1. Ceiling mounted - Flat White
 2. Wall mounted - Flat White, verify with Architect
 3. Floor mounted - Shall be coordinated with Architect
 4. Duct mounted - Light grey prime coat on steel materials and natural non-oxidizing finish on aluminum
 5. Opposed blade dampers - Black
 6. Other as called for in the Schedule
- F. A sponge rubber gasket shall be provided on back side edge of all mounting frames to provide a snug tight fit to construction surfaces.
- G. Where round ductwork is used, provide a square-to- round adapter with the air device.
- H. Slot diffusers shall comply with the following:
1. Diffuser shall include a factory fabricated plenum of minimum 26 gauge galvanized steel.
 2. Inside of plenum shall be internally insulated with 1/2" duct liner. Liner shall meet specifications for duct liner indicated above.
 - a. Portions of plenum not factory insulated shall be externally insulated with 1 ½", 1lb duct wrap per specification 230200.(specifically end caps)
 3. Plenum shall include an inlet collar for flexible round duct. Inlet shall include a balance damper.

2.10 FIRE DAMPERS

- A. General
1. Fire dampers in ducts connected to a fan shall be the UL labeled, dynamic rated fire dampers unless otherwise indicated on the plans. Fire dampers in transfer ducts not connected to a fan shall be the UL labeled, static rated fire dampers unless otherwise indicated on the plans. Dampers shall be the curtain type, except where the size is too large they shall be multi-blade type, unless otherwise indicated on the drawings.
 2. Fire dampers shall be constructed and tested in accordance with UL Standard 555. Each damper shall have a 165 degrees F fusible link (see plans for dampers with link rating of 212 or 280 degrees F).
 3. Dampers shall have Ductmate breakaway connections where either the height or width of the connecting duct is 48" or greater.
 4. When the wall or floor opening exceeds the dampers maximum UL listed multiple section assembly size, provide mullions manufactured by the damper manufacturer where so approved by their UL rating.

5. Provide factory installed sleeves for fire dampers. Sleeves shall be the same thickness as the adjacent duct, or the minimum thickness required by governing code, but not less than the following:

Max. Long Side of Duct or Diameter	Steel Gauge
0-12 inches	26
13-30 inches	24
31-54 inches	22
55-84 inches	20
85 inches and above	18

6. Provide access doors to allow resetting of fire damper and replacement of the link.
7. Fire dampers shall be manufactured by Ruskin, Air Balance, Pacific, Phillips, Prefco, Nailor, Greenheck, or Pottorff.

B. Curtain Type Fire Dampers

- Curtain type fire dampers shall be type B (type C for round ducts) unless otherwise indicated on the drawings.
- Curtain type dampers shall be gravity operated for vertical installations; dampers in a horizontal position shall have stainless steel closure spring and blade lock. Fire dampers shall be equipped for vertical or horizontal installation as required by the location indicated.
- Curtain type fire damper pressure drop shall not exceed the following:

VEL (FPM)	P.D. (W.C.)
1000	0.01
1500	0.015
2000	0.07
3000	0.15

C. Multi Blade Fire Dampers

- Type A (type C for round ducts) unless otherwise indicated on the drawings.
- Stainless steel closure spring and blade lock.
- Equipped for vertical or horizontal installation as required by the location indicated.
- Dynamically rated to close at 4,000 fpm and 4" differential static pressure.
- Galvanized steel construction, except where otherwise indicated.
- Blades: Airfoil design, double skin 16 gauge (14 gauge equivalent), max. 6-1/4" wide.
- Frames: 16 gauge, 5" x 7/8" hat channel with reinforced corners.
- Bearings: stainless steel pressed into frame.
- Provide factory installed jack-shaft with spring closer. Linkage shall be concealed in frame.
- Multi Blade fire damper pressure drop shall not exceed the following:

VEL (FPM)	P.D. (W.C.)
1000	0.02

1500	0.04
2000	0.07
3000	0.15

- D. Curtain type dampers shall be Ruskin model DIBD2 (1-1/2 hour) and DIBD23 (3 hour) for dynamic type and IBD2 (1-1/2 hour) and IBD23 (3 hour) for static type unless otherwise indicated on the plans. Multi-blade type dampers shall be Ruskin model FD-60 (1-1/2 hour) and FD-31 (3 hour) unless otherwise indicated on the plans.
- E. Ceiling Fire dampers shall be Ruskin Model CFD4W, and CFD(R) 3.5 W for passing through rated ceilings in wood construction. Provide insulation blanket for ceiling fire dampers.

2.11 COMBINATION SMOKE-FIRE DAMPERS

A. General

1. Combination smoke-fire dampers shall be the UL labeled, dynamic rated combination smoke-fire dampers as indicated on the plans. Dampers shall be the single blade type or multi-blade type as indicated on the drawings.
2. Combination smoke-fire dampers shall be constructed and tested in accordance with UL Standard 555 and UL Standard 555S. Each damper shall have a 165 degrees F fusible link (see plans for dampers with link rating of 212 or 280 degrees F).
3. Dampers shall have Ductmate breakaway connections where either the height or width of the connecting duct is 48" or greater.
4. When the wall or floor opening exceeds the dampers maximum UL listed multiple section assembly size, provide mullions manufactured by the damper manufacturer where so approved by their UL rating.
5. Provide factory installed sleeves for combination smoke-fire dampers. Sleeves shall be the same thickness as the adjacent duct, or the minimum thickness required by governing code, but not less than the following:

Max. Long Side of Duct or Diameter	Steel Gauge
0-12 inches	26
13-30 inches	24
31-54 inches	22
55-84 inches	20
85 inches and above	18

6. Provide access doors to allow resetting of damper and replacement of the link.

B. Single and Multi-Blade Combination Smoke-Fire Dampers

1. The following damper models shall be provided:
 - a. Round combination smoke-fire dampers shall be Ruskin FSDR-25/Class I.
 - b. Rectangular combination smoke-fire dampers shall be Ruskin FSD-60-2/Class II. Model FSD-60-2RA may be used where damper needs to be installed from one side. Model FSD-60-2GA may be used where damper can be installed with access to actuator and accessories from a grille.

- c. Equivalent dampers by Air Balance, Nailor, Greenheck, or Pottorff are acceptable.
2. Equipped for vertical or horizontal installation for the location indicated.
3. Rated to close at 3,000 fpm and 4" differential static pressure.
4. Maximum temperature - 350°F.
5. Galvanized steel construction, except where otherwise indicated.
6. Blades:
 - a. Rectangular dampers shall have airfoil design blades, double skin 16 gauge (14 gauge equivalent), max. 6-1/4" wide, and open position stop. Round dampers shall have two piece design blades, 16 gauge (14 gauge equivalent), and open position stop.
7. Frames:
 - a. Rectangular dampers shall have 16 gauge frame, 5" x 7/8" hat channel with reinforced corners.
 - b. Round dampers shall have 20 gauge frame with an integral sleeve, 16.75 inches long with retaining plates.
8. Bearings: stainless steel or oil impregnated bronze, pressed into frame..
9. Seals - Silicone rubber blade edge seals and flexible stainless steel jamb seals.
10. Linkage for rectangular dampers shall be concealed in frame.
11. Axles - 1/2" plated steel hex.
12. EFL electronic fuse link, heat actuated release device, which will allow the damper to reopen.
13. Factory supplied damper sleeve, minimum 17 inches long suitable for duct connections as indicated on the plans.
14. For multiple section dampers, each section shall be operated by a separate actuator.
15. Damper pressure drop shall not exceed the following:

VEL (FPM)	Rectangular P.D. ("W.C.)	Round P.D. ("W.C.)
1000	0.05	0.01
1500	0.12	0.02
2000	0.20	0.04
3000	0.45	0.09

C. Combination Smoke-Fire Damper Actuators

1. The actuator shall be Belimo model FSNF-24 actuator.
2. The actuator shall be factory mounted and connected to the damper sleeve section.
3. Control circuit - Two wire, 24 vac. Watts - 18 running/ 6 holding. Temperature rating - 350°F. Connections - 3 foot long plenum rated cable for connection to a junction box. Provide all necessary low voltage transformer(s).
4. No load timing - at 75°F, 15 seconds/180°. Spring return timing -with full load opposing spring approximately 15 seconds. Return to normal position when power is removed.
5. Rated torque of each actuator shall be 70 in-lbs. Size all actuators to operate damper with reserve power.

6. Case - NEMA 1 housing.

2.12 MOTORIZED DAMPERS

A. Motorized Dampers shall be:

1. Rated per AMCA standard 500: Pressure drop rated in accordance with figure 5.3; leakage rated in accordance figure 5.5.
2. Rated for up to 180 degrees F.
3. 1/2" diameter x 2" long axles, cadmium plated steel (or hex or square).
4. Stainless steel axle bushings.
5. Blades securely attached to shaft.
6. Linkage shall be concealed in frame and shall be plated steel bars with stainless steel pivots.
7. Maximum pressure drop shall be rated for a 24"x24" test duct.

B. Type A Motorized Dampers shall be equal to Ruskin CD-60 with the following features: Nailor 1120, American Warming VC-27 or approved equal by Pottorff, Penn, or Greenheck shall be equally acceptable.

1. Opposed blades.
2. Allowable velocity of 3000 FPM (48" - 60" long blades) and 4000FPM (max. 48" long blades) and differential pressure of 3.5" W.G.
3. Frame - 5" x 1" x 16 gauge galvanized steel hat channel.
4. Blades - Airfoil shaped, double skin galvanized steel construction of 14 gauge equivalent thickness, maximum 6" wide. Blade extensions may be used on top and/or bottom blades to meet damper size requirements without diminishing free area.
5. Seals - Extruded vinyl blade edge seals and flexible metal compressible jamb seals.
6. Finish - Mill galvanized.
7. Maximum pressure drop at 3000 fpm shall not exceed 0.30" W.G.
8. Damper torque requirements shall not exceed 5 in-lbs per ft. for opposed blade dampers and 7 in-lbs per ft. for parallel blade dampers.
9. Maximum Leakage per Sq.Ft. at 1" W.G. differential pressure: 3.0 CFM for dampers 12" to 24" wide and 2.0 CFM for dampers greater than 24" wide.
10. Maximum single dampers section shall be 60" wide x 72" high.
11. For multiple section dampers, each section shall be operated by a separate actuator.
12. Mount actuators directly to a 1/2" diameter control shaft with outboard support bearing that extends 6" beyond the damper frame.

C. Motorized damper actuators shall have the following features.

1. Actuators shall be Belimo model AF24-SR or equivalent by Siemens or Siebe. No other substitutions allowed.
2. Actuators shall be connected to the dampers as shown in details on the drawings. Provide all needed linkages and materials for a complete operating damper.
3. Actuators shall be factory mounted and connected to the damper section(s).
4. Size all actuators for minimum of 130% of the torque required to operate the damper(s).
5. Maximum time for full stroke or return of 135 seconds. The spring return running time shall be approximately 40 seconds.

6. Each actuator shall have a minimum torque of 133 in-lbs.
7. The actuator shall have spring return for fail-safe operation. During normal operation the actuator shall not work against the force of the spring.
8. The actuator shall be powered by either 24 VAC or 24 VDC. Power consumption shall not exceed 6 watts. Actuator control shall be proportional by a 0 to 10 VDC or 4 to 20ma signal, with the addition of a 500 ohm resistor. Provide all necessary low voltage transformer(s).
9. Provide a conduit connection for actuators located in mechanical rooms or outdoors and a 1 foot long plenum rated cable for connection to a junction box for actuators located in ceiling plenums.
10. Actuator shall have built in overload protection to prevent damage to the actuator when the actuator or damper reaches its end position. End switches are not acceptable.
11. Actuator shall be UL listed and labeled.
12. Actuator shall be designed for a minimum 60,000 open-close cycles and 1000 spring return cycles.

2.13 BALANCE DAMPERS

A. General

1. All balance dampers occurring in concealed ductwork, except those above removable ceilings, shall be installed with shafts vertical.
2. Provide control rod extending beyond the duct with a single locking quadrant for all volume dampers. Locking quadrant shall be continuously adjustable throughout a 90 degree operating range.
3. For dampers in ducts with liner, provide hat channel to match liner thickness; for dampers in ducts with external insulation, provide hat channel under locking quadrant same thickness as insulation.
4. Blade extensions may be used on top and/or bottom blades of Multi-blade dampers to meet damper size requirements without diminishing free area. Multi-blade dampers shall have opposed blades and shall be tested in accordance with AMCA standard 500, figure 5.3.

B. Single Blade Dampers shall be allowed in ducts up to 2.25 sq. ft.

1. Single Blade Dampers shall have 16 gauge galvanized steel or 0.090" aluminum reinforced blades, 16 gauge galvanized steel or 0.090" aluminum frames, 1/2" diameter (or hex or square) shafts that are minimum 2" long, and nylon or bronze axle bushings. Securely attach blades to shaft. Dampers shall be rated for up to 1,500 fpm and 1" differential static pressure. Provide volume dampers integral with "spin-in" where appropriate or indicated. Single blade dampers shall be Vent Products model 5101 (rectangular), model 5301 (round), or approved equal by Ruskin, Nailor, or American Warming.
2. Alternate Single Blade damper Construction: Similar construction to above except blade and shaft may be shop fabricated and mounted in duct (or spin-in) without a separate damper "frame." Provide shaft continuously through duct with locking quadrant on one end and end bearing on other end. End bearing shall be Young Regulator No. 656 or approved equal.

- C. Multi-blade Dampers shall be provided in ducts over 2.25 sq. ft. and shall be rated for 180 degrees F. Maximum pressure drop shall be rated for a 24"x24" test duct. Dampers shall be materials indicated below with 1/2" diameter axles (or hex or square) that are min. 2" long with nylon or bronze axle bushings. Securely attach blades to shaft. Linkage shall be plated steel bars with bronze or stainless steel pivots and shall be concealed in frame. Jamb and blade seals are not required.
1. Multi-blade dampers for Ducts up to 4.5 sq. ft.
 - a. Rated for 1,500 fpm and 2" differential static pressure.
 - b. Maximum pressure drop at 1,500 fpm shall not exceed 0.10" W.G.
 - c. Galvanized steel or aluminum.
 - d. Blades: 16 gauge, max. 6" wide.
 - e. Frames: 16 gauge, 5" x 7/8" hat channel with reinforced corners.
 - f. Dampers shall be Nailor model 1022, American Warming model VC-2, Ruskin Model CD-35, or approved equal by Pottorff, Penn, or Greenheck.
 2. Multi-blade dampers for Ducts over 4.5 sq. ft.
 - a. Rated for 3,000 fpm and 3" differential static pressure.
 - b. Maximum pressure drop at 3000 fpm shall not exceed 0.30" W.G.
 - c. Galvanized steel, except where otherwise indicated.
 - d. Blades: Airfoil design, double skin 16 gauge (14 gauge equivalent) or 0.081" thick 6063-T5 extruded aluminum, max. 6-1/4" wide.
 - e. Frames: 16 gauge, 5" x 7/8" hat channel with reinforced corners.
 - f. Provide factory installed jackshaft with all multiple section dampers.
 - g. Dampers models shall be Nailor 1120, Ruskin CD-60, American Warming VC-27 or approved equal by Pottorff, Penn, or Greenheck.
 3. Multi-blade dampers for Ducts over 10.0 sq. ft. - Low Pressure Drop Damper (where indicated on the drawings).
 - a. Rated for 3,000 fpm and 3.5" differential static pressure.
 - b. Maximum pressure drop at 3000 fpm in a 24"x24" test duct shall not exceed 0.15" W.G.
 - c. Extruded aluminum, except where otherwise indicated.
 - d. Blades: Airfoil design, 0.081" thick 6063-T5 extruded aluminum, max. 6-1/4" wide.
 - e. Frames: 16 gauge galvanized steel, 5" x 7/8" hat channel or 0.125" thick 6063-T5 extruded aluminum, with reinforced corners.
 - f. Provide factory installed jackshaft with all multiple section dampers.
 - g. Dampers models shall be Nailor 2020, American Warming VC-29, Ruskin CD-50 or approved equal by Pottorff, Penn, or Greenheck.

2.14 BACK DRAFT DAMPERS

- A. Back draft dampers shall comply with the following:
1. Shall have minimum 2", 0.125" thick extruded aluminum frame reinforced for rigidity.
 2. Aluminum blades of maximum 6" width.
 3. Adjustable counterweight.

4. Cadmium plated steel shafts.
 5. Blade shafts shall operate in ball bearings.
 6. Hardware shall be cadmium plated steel with brass pins.
 7. Dampers shall include blade edge seals. Leakage shall be less than 12 cfm per sq. ft. at ½ inch W.G.
 8. Use multiple damper sections for sizes above 48" x 48".
- B. Back draft dampers shall be Ruskin model BD-6 or approved equal by NCA, Greenheck, Pottorff Nailor.

2.15 ACCESS DOORS

- A. Access doors for ductwork shall be minimum 22 gauge galvanized steel with a continuous piano type hinge and camlock(s) (1 for doors 16" and 2 for larger doors); air leakage shall not exceed 0.21 CFM per square foot at 1 inch static pressure. Doors shall be 24" x 24", except for small ducts, where doors shall be as large as practical. Doors shall include a seal between the door and frame and shall also include a seal between the frame and duct. Doors shall be Ruskin model ADH 12 or equal by Pottorff, A.J Manufacturing, or approved equal.

2.16 LOUVERS

- A. The scheduled Ruskin louver selection is to establish the desired style, quality, type and performance. Equal products by NCA, Nailor, Pottorff, Air Balance, or Greenheck are acceptable.
- B. Louvers shall be constructed of aluminum with an anodized aluminum finish and shall include a matching sill extension.
- C. Blades shall be minimum 0.08" extruded aluminum and shall be 6" storm-proof design.
- D. Louvers shall bear the AMCA certified rating seal for air performance and water penetration.
- E. Water penetration shall not exceed 0.01 oz. of water per ft² in 15 minutes when tested in compliance with the standard described above at a free area velocity of 500 fpm.
- F. Maximum pressure drop shall not exceed 0.035" w.c. at a free area velocity of 500 fpm. Pressure drop rating shall include the birdscreen.
- G. Louver shall include ½" x ½" mesh 0.063" aluminum birdscreen.

PART 3 - EXECUTION

3.1 HANGING AND SUPPORTING DUCT WORK

- A. All ductwork shall be neatly supported and properly anchored to building construction so horizontal ducts are without sag or sway, vertical are without buckle and all are free from the possibility of deformation collapse or vibration.
- B. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA 2005 Tables 4-1 through 4-3 and Figures 4-1 through 4-9.
- C. Install single wall ductwork except where double wall ducts are indicated on the plans.

- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection. Provide trapeze hanger diagonally under all elbows greater than 54 inches wide.
- E. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- F. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load.
- G. Hanger rods shall have double nuts and lock washers at all connections.
- H. Install concrete inserts prior to placing concrete.
- I. Install drilled inserts and powder actuated concrete fasteners after concrete is placed and completely cured. Obtain approval of the Engineer prior to using powder actuated concrete fasteners.
- J. Duct shall not be supported from metal roof deck.

3.2 DUCT INSTALLATION, GENERAL

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Verify exact locations and space requirements of ducts at the site and coordinate work with other trades, before fabricating ductwork.
- C. Install ducts with the fewest possible joints.
- D. Use fabricated fittings for all changes in directions, changes in size and shape, and connections. Provide all drops, raises, transitions, or offsets as required, at no additional cost to the Owner, Architect or Engineer, due to obstructions. When additional offsets, etc., different from those shown are required, approval shall be obtained from the Engineer prior to proceeding. All size or shape transitions shall be made gradually with angle not to exceed 15 degrees on each side.
- E. Install branch take-offs tight to duct wall with projections into main duct kept to a minimum. Ragged edges projecting into the main duct shall not be allowed.
- F. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct usable space or block access for servicing building and its equipment.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. The sheet metal work shall be coordinated with that of other trades in such a manner that when the installation is complete, all items are properly installed and are serviceable.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

- J. Coordinate layout with ceiling, lighting layouts, sprinklers and other piping.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with escutcheon of sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 2 inches.
- M. Branch Connections: Comply with SMACNA 2005 Figures 4-5 and 4-6.
 - 1. Install radius elbows and vaned elbows where shown on the plans. Radius elbows may be substituted for vaned elbows, but vaned elbows shall not be substituted for radius type unless approved in writing by the Engineer. 45 degree taps and other taps shall not be substituted for elbows.
- N. Outlet and Inlet Connections: Comply with SMACNA 2005 Figures 7-6, 7-7 and 10-1 and as indicated on plans.
- O. Flexible Connections at Fans: Comply with SMACNA 2005 Figure 7-8.
- P. Provide openings in ductwork where required to accommodate thermometers and temperature sensors.
- Q. Clean duct system and force high velocity air through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.
- R. During construction all open ends of installed ductwork shall be kept covered to prevent dirt and debris from entering ducts. Openings shall be covered with plastic sheeting held in place with duct tape or utilize Dyn-O-Wrap DW/PRW/RPRW or equivalent. Any ducts stored on site shall be protected by keeping them raised off the ground.
- S. Ducts shall be neatly finished on the outside with all sharp edges removed. Inside surfaces shall be smooth with no projections into the air stream.
- T. All fasteners and attachments shall be made of the same material as the ducts or of corrosion-resistant material.
- U. Ducts up through 2" pressure class shall have all transverse duct joints sealed in compliance with the sealant manufacturer's recommendations and SMACNA procedures for Seal Class C. Ducts over 2" pressure class shall have transverse and longitudinal joints sealed in compliance with the sealant manufacturer's recommendations and SMACNA procedures for Seal Class A.
- V. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance. Dissimilar metals shall be connected with flanged joints made up with neoprene gaskets to prevent contact between metals. Flanges shall be fastened with bolts protected by ferrules and washers made of the same material as the gaskets.

- W. Where dampers are installed in ducts having external duct insulation, install damper locking quadrants with hat channel or of same depth as insulation to allow smooth operation of dampers.
- X. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Provide hanging materials that match the appearance of the exposed ducts.
- C. Remove any identification labels or markings from ducts so appearance of ducts at such locations matches the remainder of the ducts.
- D. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- E. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- F. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- G. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 INSTALLATION OF RESIDENTIAL KITCHEN HOOD EXHAUST DUCTS

- A. All joints shall be continuously welded.
- B. Joints exposed in a room shall be welded and shall be ground smooth to achieve a finished appearance.
- C. Joints in concealed locations shall be welded but do not need to be ground smooth.
- D. Seams in horizontal ducts shall be on the top side.

3.5 INSTALLATION OF DRYER EXHAUST DUCT

- A. Dryer duct shall not have any fasteners within air stream. Interior of duct shall be smooth, free of any possible lint catching ridges and with push fittings in direction of airflow.

3.6 LEAKAGE TESTING

- A. Ducts, plenums, and casings shall be tested and made substantially airtight at static pressure indicated for the system before covering with insulation or concealing in masonry. The term, "substantially airtight," shall be construed to mean that no air leakage is noticeable through the senses of feeling or hearing.

3.7 DUCT CLEANING

- A. Clean new and existing duct system(s) to remove oil film and dust before testing, adjusting, and balancing.

3.8 FLEXIBLE ROUND DUCT INSTALLATION

- A. Application
 - 1. Flexible round ductwork may be used where shown on the drawings.
 - 2. Provide low pressure flex ducts in ducts rated 2" static pressure class or less.
 - 3. Provide high pressure flex ducts in ducts rated over 2" static pressure class.
 - 4. Flexible duct shall not pass thru any wall, floor or ceiling.
- B. Slide vapor barrier and insulation away from ends. Secure flex duct to diffusers and main duct takeoff with flame retardant nylon or stainless steel draw bands. Slide vapor barrier and insulation back over flex duct and secure in place with draw band or duct tape. Apply duct sealer if necessary to obtain a leak tight connection. Nylon cable ties shall be 0.19 inch width minimum, with standard cross-section and shall comply with UL-181 or UL - 2043.
- C. All flexible duct shall be routed and supported in such a manner that the duct is not flattened in any area and that full cross sectional area is maintained. All bends shall be made in such a manner that the ratio of the center line radius of the bend to the inside diameter of the duct is not less than 1. Support flexible ducts from building structures in accordance with SMACNA 2005 Figure 3-10 or 3-11. Provide a sheet metal saddle between the insulation and strap, to prevent duct from sagging excessively and from resting on lights, ceilings, etc.
- D. Where flex duct turns 90°, provide a 90° sheet metal elbow or support the flex duct through the turn with a "Flex Flow Elbow" by Thermaflex or equal.
- E. All bends shall be made so that the ratio of the center line radius of the bend to the inside diameter of the duct is not less than 3.
- F. Maximum length of flexible ducts shall be 8 feet unless otherwise indicated.

3.9 FLEXIBLE CONNECTOR INSTALLATION

- A. Flexible connectors shall be provided where fans, air handling units, fan terminal units, fan coil units, and rooftop units connect to ducts or casings to prevent transmission or vibration to ductwork.
- B. Flexible connectors shall fit tightly around ducts and fans and shall be securely bolted in place.
- C. Joints between flexible connectors and duct or fan shall be sealed with duct sealer.

3.10 FIRE DAMPER INSTALLATION

- A. Damper installation shall be in compliance with NFPA #90A, UL requirements and manufacturer's installation instructions.
- B. Fire dampers shall be installed in all ducts and openings through fire rated partitions, ceilings and floors, where required by Code, and where indicated on plans.

- C. Minimum fire damper width shall be 12" unless otherwise indicated. Provide duct transition if necessary to achieve the minimum width. Provide an access door in the duct and/or an access panel in the wall or ceiling to allow resetting the damper. All dampers must be installed so the fusible link is accessible.
- D. Provide 1-1/2 and 3 hour rated fire dampers at locations shown on the drawings or as required by governing codes.

3.11 COMBINATION SMOKE-FIRE DAMPER INSTALLATION

- A. Damper installation shall be in compliance with NFPA #90A, UL requirements and manufacturer's installation instructions.
- B. Combination smoke-fire dampers shall be installed in all ducts and openings through fire rated shafts, where required by Code, and where indicated on plans.
- C. Provide an access door in the duct and/or an access panel in the wall or ceiling to allow resetting the damper. All dampers must be installed so the electronic fusible link and actuator are accessible. Where a duct is not wide or high enough for the smoke detector to be installed, provide a transition in the duct to allow the smoke detector installation.
- D. Provide 1-1/2 and 3 hour rated combination smoke-fire dampers at locations shown on the drawings or as required by governing codes.

3.12 BALANCE DAMPER INSTALLATION

- A. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts. Install minimum 2 duct widths from duct take-off. Provide balance dampers where shown or where required to properly balance and direct air flow.
- B. Every supply air outlet shall have a balance damper at the branch duct takeoff to the supply outlet regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- C. Exhaust grilles shall have a balance damper at the branch duct connection to the main duct.
- D. Install damper control devices on stand-offs where required to allow complete coverage of insulation.

3.13 LOUVER INSTALLATION

- A. Install louver and sill extension in building opening where indicated. Secure louver to structure in accordance with manufacturer's instructions.
- B. Seal between louver and building opening to prevent moisture entry.
- C. Connect ducts to louvers, plenums, and casings and seal to prevent leakage.
- D. Provide drain in ducts, plenums, and casings to allow moisture that bypasses the louver to be removed.

3.14 BACK DRAFT DAMPER INSTALLATION

- A. Back draft dampers shall be installed on exhaust fans where scheduled and other locations where indicated on drawings.

3.15 MOTORIZED DAMPER INSTALLATION

- A. Coordinate with Section 230960 for actuator requirements.
- B. Install motorized dampers per manufacturer's instructions.
- C. Actuators shall be installed on the outside of ducts unless otherwise indicated. Provide access doors where damper motors are concealed in ducts.
- D. Install damper control devices on stand-offs where required to allow complete coverage of insulation.

3.16 ACCESS DOOR INSTALLATION

- A. Provide access doors in ducts at fire dampers, where actuators for motorized dampers are concealed inside ducts, and at other items located in ducts or plenums where access into ductwork is required for maintenance or installation of work by other trades.

3.17 TEST OPENING INSTALLATION

- A. Provide test openings in ductwork for testing and balancing.
- B. Patch insulation, ductwork, and housings, using materials identical to those removed.
- C. "Plastic Plugs" may be used to seal openings where duct traverses are made.
- D. Provide Pitot tube openings where required for testing of systems. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

3.18 INSTALLATION OF DUCT SMOKE DETECTORS

- A. Install duct detectors furnished in Section 260721 or Section 230960 per manufacturer's instructions in ductwork or air handling units where indicated. Where a duct is not wide or high enough for the smoke detector to be installed, provide a transition in the duct to allow the smoke detector installation.

3.19 INSTALLATION OF DUCT MOUNTED CO2 SENSORS

- A. Install duct mounted CO2 sensors furnished in Section 230960 in ductwork or air handling units where indicated per manufacturer's instructions.

3.20 AIR DEVICE INSTALLATION

- A. Air direction patterns shall comply with those shown and adjustments shall be made to prevent impingement of moving air on walls. Coordinate locations of outlets and inlets with other contractors to avoid interferences and to effect proper installation. Outlets in lay-in ceilings shall be located as close to positions shown on plans as the ceiling grid will allow; notify Architect and Engineer before proceeding if ceiling grid will not allow layout shown.

- B. Diffusers and grille layouts shown on the plans have been coordinated with the layout of the ceiling grid to establish the desired arrangement of grilles and diffusers. Prior to installing any ductwork which would be affected by the grid layout, verify the grid layout with the Architectural ceiling plans and the actual ceiling layout.
- C. Provide a square-to-round or round-to-square adapter with the air device where necessary to connect to the ductwork shown.
- D. Fasten air device frames and borders to drywall ceilings and walls where required. Provide a plaster ring to allow lay-in style devices to be used for drywall installations.
- E. Clean construction dirt from all air devices.
- F. Provide extension duct collar from ductwork to air devices connected to rigid duct. Fasten with sheet metal screws and seal. Where air devices are installed on exposed ductwork, provide 4" extension collar with dimensions equal to the outside dimensions of the air device and mounting flange turned inward.
- G. Diffusers shall be connected to flexible ductwork as follows:
 - 1. Fasten frames and borders to drywall ceilings where required.
 - 2. Slide flexible duct over collar of diffuser. Secure flexible duct to duct collar with flame retardant nylon cable tie(s) or stainless steel drawbands. Secure with an installation tool approved by the cable tie manufacturer. Nylon cable ties shall be 0.19 inch width minimum, with standard cross-section and shall comply with UL-181 or UL - 2043.
 - 3. Clean construction dirt from diffusers.
 - 4. Remove damper operator knob and turn over to Owner's Representative.
- H. Diffusers connected to rigid duct shall be installed as follows:
 - 1. Fasten frames and borders to drywall ceilings where required.
 - 2. Fasten extension duct collar to ductwork with sheet metal screws (and seal with approved duct sealer).
 - 3. Fasten duct ring to extension duct collar with sheet metal screws.
 - 4. Clean construction dirt from diffuser.
- I. Grilles and Registers shall be connected to the ductwork as follows:
 - 1. Cut hole in return or exhaust duct.
 - 2. Fasten extension duct collar to ductwork.
 - 3. After ceiling or wall is installed, install register with sheet metal screws.
 - 4. Check to see if sponge rubber gasket is drawn up against wall or ceiling, forming an air tight seal. If not, reassemble and check.
 - 5. Clean construction dirt from register.
 - 6. Remove damper operator key from register and turn over to Owner's Representative.
- J. All grilles, registers and diffusers shall be left in a wide open position.
- K. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

- L. Paint ductwork visible behind air outlets and inlets matte black.
- M. Provide supplemental "tees" for the ceiling grid where diffusers are a different size than the ceiling tiles.

3.21 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a primer that is compatible with the duct material.

3.22 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. The duct liner shall be cut to assure snug corner joints and installed so the black surface of the liner faces the air stream. Fold and compress liner in corners to assure butted edge overlapping.
- B. Adhere a single layer of indicated thickness of duct liner with 100 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- C. On horizontal runs, tops of ducts over 12" wide and/or sides over 16" high shall be additionally secured with Gripnail or welded pins and speed clips on a maximum of 15" centers.
- D. On vertical runs, Gripnail or welded pins and speed clips shall be spaced on a maximum of 15" centers on all duct dimensions over 12".
- E. Mechanical fasteners shall start within 2" of leading edge of each section, and within 3" of the leading edge of all cross joints within the duct sections. Mechanical fasteners shall be flush with the liner surface. Clips shall be drawn down flush only and not so as to compress the liner and cause the leading edge to raise up.
- F. All exposed edges and the leading edge of all cross joints of the liner shall be sealed with edge sealer.
- G. Butt transverse joints without gaps and coat joint with adhesive.
- H. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
- I. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
 - 1. Fan discharge and upstream edges of transverse joints within 40 feet of the fan discharge.
 - 2. Where lined ducts are preceded by unlined ductwork.
- J. Terminate liner with duct build outs (metal hat sections) installed in ducts to attach dampers, turning vane assemblies, and other devices. Secure build outs to the duct wall with bolts,

screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

- K. Duct liners having a rough surface that produces an Air Friction Correction Factor greater than specified shall have the duct oversized by the sheet metal contractor to achieve the Air Friction Correction Factor indicated.
- L. Do not use multiple layers of duct liner unless approved by the Engineer in writing. If multiple layers are used, the following additional steps shall be taken:
 - 1. Adhere bottom layer of duct liner in normal manner.
 - 2. Adhere top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
 - 3. Treat the leading edges of the duct liner with metal nosing to prevent separation of the two layers.
 - 4. Use mechanical fasteners of the proper length for the double layer.
- M. The following ducts require internal lining with a 1.5 pcf density and liner thickness indicated:
 - 1. All new rectangular supply and return ductwork - 1" thick.
 - 2. Other ducts where indicated on the drawings - 1" thick.
- N. External Duct Insulation: See Section 230200 - Mechanical Insulation for application requirements.
- O. Ductwork Located Outdoors
 - 1. Ductwork shall be internally lined with duct liner as described above.
 - 2. Exterior of ducts shall be insulated and jacketed as described in See Section 230200 - Mechanical Insulation.

END OF SECTION 230900

SECTION 230910 – START-UP, CLEANING AND TESTING**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Furnish all labor, services, materials and related items necessary to complete the start-up, cleaning and testing work indicated on the drawings and/or specified herein. Work to be performed shall include, but not be limited to, the following items:
 - 1. All Air Systems
 - 2. Natural Gas Piping
 - 3. Condensate Drains
 - 4. Compressed Air Piping

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - General Mechanical Conditions.

PART 2 - PRODUCTS**2.1 PIPE CLEANING CHEMICALS**

- A. Vulcan Precleaner or approved equal by Nalco or Calgon.

PART 3 - EXECUTION**3.1 START-UP OF SYSTEMS AND EQUIPMENT**

- A. Before any systems, or parts of systems are placed into unattended operation, they shall be completely installed, pressure tested, cleaned, flushed and balanced with all operating and safety controllers installed, calibrated and operational.
- B. When started, all motors shall be checked for proper rotation, speed, and amperage. If overloading is indicated, immediate corrective measures shall be taken to prevent damage to the motor.
- C. Before systems are operated, all bearings shall be lubricated and all other liquid levels and pressures checked and if necessary corrected.
- D. Contractor shall start-up all systems and equipment and place all systems into operation. Any equipment, pieces of equipment, controls, etc., damaged or not operating properly shall be replaced at this contractor's expense.
- E. Contractor shall verify proper and safe operation of all equipment, components, controls and control circuits before any system is left unattended.
- F. Whenever air systems are operated, air filters shall be in place. Air systems shall not be operated at any time without filters.

3.2 PIPE SYSTEMS TESTING

- A. Except for those pipes hereinafter listed, all piping installed by this Contractor shall be pressure tested. (See Plumbing Section for testing of plumbing piping.)
- B. Perform the following tests on compressed air piping:
1. Use oil-free dry air or gaseous nitrogen as a testing medium.
 2. Isolate tanks and compressors.
 3. Subject piping system to test pressure as indicated below and that is not less than 1.5 times the system's working pressure, but not less than 150 psig. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Isolate test source and let stand for four hours to equalize temperature. Refill system, if pressure has dropped, to test pressure and hold for two hours with no drop in pressure.
- C. Perform the following tests on refrigerant piping:
1. See test requirements in Section 230150 "Refrigerant Piping."
- D. The following pipes do not require a pressure test:
1. Air Handling Unit and DX coil condensate drains.
- E. Any item which might be damaged by the pressure test shall be removed from the system during the test, or isolated from the test.
- F. Gauges used for testing shall be tested for accuracy, and then installed as close as possible to the low point of the system to be checked.
- G. No leakage is permitted. Leaks shall be repaired and the lines retested.
- H. Any lines changed after testing shall be retested.
- I. Test data shall be recorded on a standard form.
- J. While piping is under test, care shall be taken that excessive pressure does not occur due to increase of ambient temperature.
- K. Test Pressure and Medium:

LINE SERVICE	MEDIUM	TEST PRESSURE PSIG
Natural Gas	Air	100

3.3 CLEANING

- A. Adequate precautions shall be taken during storage and installation to keep the inside of all pipes, valves and fittings free from foreign materials.
- B. The inside of all pipes, valves, and fittings shall be smooth, clean, free from blister, loose mill scale, sand, dirt and other foreign material.

- C. This Contractor shall clean all piping installed by him.
- D. Natural gas piping shall be cleaned with compressed air. Piping shall be thoroughly blown clean. When complete, all dirt legs, strainers, etc., shall be cleaned. Any items in the piping system, such as gas trains or equipment, which could be affected by either the pressure or dirt shall be disconnected during the cleaning operation.

3.4 TURN OVER TO OWNER

- A. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 3. Set temperature controls so all coils are calling for full flow.
- B. When the system is turned over to the Owner, all systems shall have been started, tested, balanced and checked and proven to be fully operational in every respect.
- C. When the system is turned over to the Owner, all bearings shall have been recently lubricated, oil levels checked and oil added if necessary, liquid levels and pressures checked and corrected, flow rates checked and corrected, R.P.M.'s verified, belts tightened and aligned, and all controls and control sequences checked, verified operational and if necessary, corrected.
- D. When the system is turned over to the Owner, all air filters shall be replaced with clean filters.

END OF SECTION 230910

SECTION 230930 – TESTING AND BALANCING**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

- A. Furnish all labor, services, materials and related items necessary to complete the testing and balancing (TAB) work indicated on the drawings and/or specified herein. The scope of work shall include:
 - 1. Pre-readings - measure existing air flows prior to demolition where indicated. Report flows to Engineer.
 - 2. Balancing of all air movement systems.
 - 3. Adjusting all air devices to prevent drafts on occupants or as otherwise indicated.
 - 4. Coordinate testing and balancing with Commissioning Agent.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Mechanical Basic Materials and Methods.
- D. Section 230020 - Vibration Isolation.

1.3 All instruments used by this agency shall be accurately calibrated and maintained in good working order.

1.4 The balance work shall be performed by an AABC (Associated Air Balance Council) or a NEBB (National Environmental Balance Bureau) certified firm. All work shall be done in compliance with the standards of the certification. All balance work shall be done under direct supervision of a qualified heating and ventilating engineer employed by them. All work shall also comply with the ASHRAE Standard 111 recommendations pertaining to measurements, instruments, testing, adjusting and balancing.

1.5 The balance firm shall have a minimum of 5 year's experience balancing similar systems.

1.6 If requested, the tests shall be conducted in the presence of the Engineer or their representative.

1.7 REFERENCES

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE - 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
- C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.8 SUBMITTAL

- A. Provide submittals under provisions of Section 230000.
- B. Within 30 days of award of the contract, submit:

1. Name and qualifications of testing, adjusting and balancing agency for approval by the Engineer.
 2. Submit sample balance report forms and detailed procedures for approval by the Engineer.
 3. Forms shall be representative for all the tests. Formulas and data to be used for determining heat exchange capacities, where required, shall be included.
- C. Submit 3 bound copies of draft report for review prior to final acceptance of Project.
- D. Submit 5 bound copies of final reports to the Engineer for inclusion in operating and maintenance manuals.
- E. Provide reports in soft cover, letter size, multi-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- F. Reports shall include the following information:
1. TAB Company name, address, and telephone number.
 2. Project name, location, Project Architect, Project Engineer, and Project Contractor.
 3. Project altitude.
 4. Instrument List:
 - a. Instrument.
 - b. Manufacturer.
 - c. Model.
 - d. Serial number.
 - e. Range.
 - f. Calibration date.

1.9 QUALITY ASSURANCE

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum three years documented experience. Perform work under supervision of AABC Certified Test and Balance Engineer.
- B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

1.10 SCHEDULE

- A. Sequence work to commence after completion of systems. Schedule completion of TAB work before Substantial Completion of Project.
- B. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.
- C. Draft air balance reports shall be submitted a minimum of 5 days prior to substantial completion.

1.11 PREPARATION FOR TESTING AND BALANCING

- A. The Mechanical Contractor shall bring the work to a state of readiness for testing and balancing all equipment and systems by doing the following:
1. Install air terminal devices.
 2. Install all balancing devices. Leave them accessible, readily adjustable, and in the open position.
 3. Verify lubrication of all equipment.
 4. Permanent instrumentation to be operational.
 5. Check rotation and alignment of rotating equipment and tension of belt drives.
 6. "Start-up" HVAC equipment and continue operating the equipment during the testing and balancing.
 7. Verify rating of overload heaters in motor starters.
 8. Set control points of automatic controls and check calibrations and adjustments.
 9. Repair or replace at this contractor's expense components of system which do not function properly.
- B. Mechanical Contractor shall assist the balance firm as follows:
1. Provide TAB firm with copy of the HVAC plans, specifications and approved equipment submittals.
 2. Change, at the Mechanical Contractor's expense, pulleys, belts, drive, etc., required to obtain correct air balance.
 3. Add, at the Mechanical Contractor's expense, dampers and/or valves as required by the TAB firm to correctly balance the HVAC systems.
 4. Repair duct leaks identified by the TAB firm.
 5. Put all HVAC equipment and systems into operation and continue the operation during each working day of TAB, as required.
 6. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.
 7. Provide temperature and pressure taps according to the Construction Documents for TAB testing.

1.12 DEMONSTRATION

- A. Demonstrate as follows:
1. The TAB Firm shall be prepared to demonstrate to the Engineer and the Owner that actual conditions match the balancing report. At the Engineer's discretion:
 - a. Retest no more than 30% of the supply, return and exhaust outlets to demonstrate that they are reading what the balance report indicates.
 - b. Retest no more than 30% fan, etc., systems to demonstrate that they are operating at conditions indicated in the balancing report.
 - c. Retest no more than 30% of controls relative to the mechanical equipment to demonstrate that they are operating properly.
 - d. Retesting shall be done in cooperation with the Engineer and the Owner's personnel and in their presence if requested.

PART 2 - PRODUCTS

2.1 MEASUREMENTS AND INSTRUMENTATION

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.
- J. Prepare and submit a profile of the air flow across all coils in all air handling units.

PART 3 - EXECUTION

3.1 The TAB firm shall perform the following tests, balance the system in accordance with the following requirements, and report the following data.

- A. General
 - 1. Report manufacturer, model, type, size and location of all equipment and devices.
 - 2. All equipment except RTU supply fans (see below for RTUs) shall be balanced to within 10% of design flow.
 - 3. TAB firm shall review ductwork and piping drawings and inspect the ductwork and piping during construction to assure that balancing dampers and valves are installed where needed to allow proper air and water balancing and to assure that dampers and valves are accessible. Advise Engineer and Mechanical Contractor of deficiencies. Mechanical Contractor shall include the cost of additional dampers and valves in his bid.
- B. Air Distribution Devices
 - 1. Identify and locate each air device. Use manufacturer's ratings on all equipment to make required calculations. Report required CFM and resultant CFM after final adjustments. Report percent of design air flow.

2. Balance all supply, return, and exhaust air devices to within 10% of design flow. Use volume control devices on air devices to regulate air quantities only to extent that adjustments do not create objectionable sound levels. Effect volume control by duct mounted dampers.
3. Adjust deflection vanes on all air devices as indicated on plans and schedules and to minimize drafts in all areas. Adjust return air devices to block line of sight into return air duct or plenums.

C. Roof-Top Units

1. Adjust supply fan RPM to design requirements. Fans with variable frequency drives, adjust fan CFM to within -0%, +5% of scheduled air flow with an allowance made for the filters being at half their rated dirty pressure drop.
2. Fan motor amperes at design RPM.
3. Make Pitot tube traverse of main supply and return ducts to verify design CFM.
4. Cooling coil entering and leaving air DB and WB temperatures.
5. Report simultaneous heat exchange capacity of cooling coil at full load (BTU/HR).
6. Adjust outside air dampers to achieve rated minimum CFM with units at 100% air flow. Coordinate with Temperature Control contractor to fine tune control fresh air damper actuators for correct minimum outside air CFM.
7. For RTU's with economizer set controls for full economizer operation and measure outside air CFM, return air CFM and relief air CFM.

D. Exhaust Fans

1. Measure full load amperage of all fans.
2. Set correct RPM's on fans with adjustable drives.
3. Check all fans for noise and recommend corrections if ambient noise requires adjustment.
4. Make pitot tube traverse of main duct and adjust fan RPM to obtain design CFM. If units have fixed pitch sheaves, and unit cannot obtain design CFM, replace with new fixed pitch sheaves of required pitch diameter to obtain design CFM.
5. Report fan inlet and outlet static pressures.

E. Electric Heating Coils

1. Design KW, number of stages, and design amperage per phase.
2. Voltage and amperage (each phase).
3. Air flow, specified and actual.
4. Temperature rise, specified and actual.

F. Unit Heaters and Cabinet Heaters

1. Verify if unit is operating properly at operating capacity.
2. Report fan cfm.
3. For electric or hydronic heaters, report electric or hydronic coil performance as defined above. For gas heaters, report temperature rise across heat exchanger.
4. For gas fired units with flue fans, verify that flue fans are operating properly.

G. VAV Terminal Units

1. Adjust CFM to required maximum, minimum, and heating design flows.
2. Report electric coil performance as defined above.
3. List mechanical/electrical data.
4. Record system static suction and discharge pressure for full primary air.

H. Fan Coil Units

1. Adjust cfm to required design flow.
2. Report full load amperage of fan motor.

I. Computer Room Air Conditioner

1. Set RPM to design CFM of fans.
2. Full load amperage of fans.
3. Suction pressure and discharge pressure of fans.
4. Adjust each air handling unit for design CFM supply air.

J. Measurements of Existing Systems

1. Air System

- a. Prior to beginning any system modifications, the following data shall be recorded and submitted immediately to SSC Engineering. No rebalancing is to be performed until modifications to the systems are complete.
 - 1) The RPM speed of each supply and return fan in the main air handling unit and with the variable speed drive controllers set at 100%.
 - 2) The static pressures in the return duct upstream of the mixing box; in the inlet plenum for the return air fan; in the outlet plenum just downstream from the return air fan (note and record position of outdoor air and relief dampers); in the mixed air plenum; in the supply fan inlet plenum; in the supply fan outlet duct. All static pressures shall be measured relative to a common datum point, which shall be noted on the report.
 - 3) Where indicated on the plans, a duct traverse or air device flow measurement shall be made to verify existing flows in the system.
- b. Upon completion of the remodeling work, the supply air system shall be proportionately balanced to the air quantities shown on the drawings. Supply and return fan speeds are to be initially adjusted using the existing variable frequency drives. The supply air fan shall be set to run at the same minimum speed necessary to maintain the same static pressure in the supply ductwork as measured before the system was modified. Following approval by the Engineer, the fans shall be re-sheaved to achieve the scheduled airflow.

3.2 Terminal Unit Data:

1. Type, variable, single duct.
2. Minimum static pressure.

3. Minimum design air flow.
4. Maximum design air flow.
5. Maximum actual air flow.
6. Inlet static pressure.

3.3 TESTING AND BALANCING FIRM'S RESPONSIBILITIES – COMMISSIONING OF MECHANICAL SYSTEMS

A. Systems Testing Meeting

1. Attend the Pre-Balancing Meeting to finalize coordination efforts and verify the operation and readiness for testing, adjusting, and balancing. This meeting will include planning for the Systems Testing Meeting.

B. HVAC Controls

1. Perform the Operational tests and record the results.
2. Report the test results.
3. Discuss deficiencies with the Engineer.

END OF SECTION 230930

SECTION 230960 – TEMPERATURE CONTROLS**PART 1 - GENERAL**

- 1.1 This Contractor shall furnish and install a complete system of temperature controls. This system shall include all controllers, thermostats, control devices, wiring, etc., required to accomplish the sequence hereinafter described.
- 1.2 All power wiring shall be in conduit and shall meet the latest edition of NEC. All control wiring shall have plenum rated insulation.
- 1.3 Related Documents
 - A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
 - B. Section 230000 - Mechanical General Conditions.
 - C. Section 230010 - Basic Materials and Methods.
 - D. Section 230020 - Vibration Isolation.
 - E. Section 230900 - Air Distribution - motorized dampers
 - F. Section 230930 - Testing and Balancing.
 - G. Division 26 - Fire Alarm System - Smoke Detectors.
- 1.4 SUBMITTALS
 - A. General
 1. Meet all applicable Submittal requirements of Division 1, Division 23, and the following including listed below.
 2. Provide to the Engineer all information or data necessary to determine compliance with these specifications.
 3. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, including specific requirements indicated.
 4. All Drawings and Diagrams shall be machine drafted using AutoCAD or Microsoft Visio. At project closeout, provide copy of control drawings and layout drawings.
 5. Provide system device and LAN conduit routing drawing, using building plans for a background. All controllers, gateways, hubs, devices and communication cabling shall be accurately shown, except that individual sensor I/O wiring and devices need not be shown. Layout drawings shall be the same size as the Engineer's construction documents.
 - B. Hardware - Include a complete list of materials of equipment to be used, including technical data, performance curves, project specification sheets and installation/ maintenance instructions.

- C. Control System Diagrams - Provide schematic diagrams for each controlled system. Illustrate the relationship between control system and controlled equipment. Show all control elements. Show all terminations and cable/tube numbers.
1. Provide equipment interface details using actual equipment termination information. Blank terminals or "field verify" is not acceptable.
 2. Provide individual diagrams for each mechanical system. If two systems are identical, then a single diagram may represent multiple mechanical systems. Notations like "this part here only applies to units xxx", etc. are not acceptable.
 3. The control diagrams and sequence of operation shall be together on the same sheet and shall be suitable for posting.
 4. The sequence of operation shall reference a schematic diagram of the controlled system. The sequence of operation shall describe in words the control strategies utilized, worded in such a way to serve as an informative reference to the maintenance and service personnel who will be responsible for unit operation.
 5. Each component and instrument on the control diagrams shall have a unique tag number such as temperature element "TE-1". The sequence of operation verbiage shall make specific reference to the individual component tag numbers, such as "Controller (C-1) compares the space temperature sensor (TE-1) to set point, and modulates hot water heating coil valve (V-1) as required". The mechanical system being controlled shall be schematically drawn and show the measurement and control points, such as "TE-1" and "V-1".
- D. Point List - Provide a point list for each system controller including both inputs and outputs (I/O) point, point number, the controlled device associated with the I/O point and the location of the I/O device. Use naming convention consistent with control diagrams and sequence of operation.
- E. Sequence of Operation Documentation shall be submitted indicating the designed procedures and processes to operate and maintain the system.
- F. Project Sequence - The control system work for this project shall proceed in the following order:
1. Perform the control system installation work, including all field check-outs and tuning.
 2. Provide support to TAB personnel as specified under the paragraph "Test and Balance Support."
 3. Submit and receive approval of the Controls System Operators Manual specified under the paragraph "Controls System Operators Manuals."
 4. A third part Commissioning(Cx) Agent will oversee testing of the HVAC systems.
- G. Parts List shall be submitted listing: manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delay.
- H. Closeout Submittals
1. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

- a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
 - 2) Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
 - 3) As-built versions of submittal Product Data.
 - 4) Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
 - 5) Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
 - 6) Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - 7) Engineering, installation, and maintenance manuals that explain how to:
 - a) Design and install new points, panels, and other hardware.
 - b) Perform preventive maintenance and calibration.
 - c) Debug hardware problems.
 - d) Repair or replace hardware.
 - 8) Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
 - 9) Backup copy of graphic files, programs, and database on electronic media such as DVDs.
 - 10) List of recommended spare parts with part numbers and suppliers.
 - 11) Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - 12) Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
 - 13) Licenses, guarantees, and warranty documents.
 - 14) Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
 - 15) Owner training materials.

2. Test Reports (Submit to Cx Agent)

- a. Performance Verification Testing Report

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Bidders are responsible for confirming that the equipment they are supplying will conform to the specifications presented. Deviations from the specifications should be brought to the attention of the Engineer.
- B. All materials and equipment used shall be standard components, regularly manufactured for this system and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.

2.2 POWER FOR CONTROL PANELS, EQUIPMENT AND SYSTEMS

- A. The Controls Contractor shall be responsible for bringing all power required by the control systems from the source (lighting panel, distribution panel, etc.) to the point of use.
- B. This section shall be responsible for bringing all power required by, but not limited to, actuators, transmitters, etc. from the source (lighting panel, distribution panel, etc.) to the point of use. This includes furnishing and installing any branch circuit protection equipment and disconnecting equipment required to comply with code requirements.
- C. The Contractor shall extend existing equipment grounding system. The Contractor shall use only approved grounding clamps and connectors as manufactured by Penn-Union, Burndy, or O-Z Manufacturing Company.
 - 1. Install a green equipment grounding conductor inside all conduits. Bond all junction boxes, conduit, and equipment. Terminate equipment grounding conductor at electrical panel grounding bus.

2.3 WIRING

- A. All wiring required for installation of mechanical thermostats and controls shall be provided under this section of the specification.

2.4 CONDUIT AND WIRE

- A. All wiring shall comply with applicable codes and regulations and shall be as specified in the applicable portions of this section of the specification, the electrical section of the specification, and as indicated on the drawings.
 - 1. Conduit shall be required for: all power wiring, input/output wiring exposed to view in finished spaces, all thermostat rough-ins, wiring below 8' AFF exposed to view in unfinished spaces.
 - 2. Open wiring will be permitted: above lay-in ceilings, and unfinished spaces above 8' AFF.
 - 3. Plenum rated wire shall be used in spaces used for the return air system.
 - 4. Cable tray may be substituted for conduit at the Contractor's option for input/output wiring in mechanical equipment rooms.
 - 5. Wire mold shall be required for all low voltage wiring for thermostats installed on concrete columns. Wire mold shall be similar to Wire mold Series "2700".
- B. Conduit Material:

1. Electrometallic tubing shall be installed for all exposed work and for all concealed work in applications where conduit is required.
 2. Provide conduit as specified in Specification Section 260130.
- C. Provisions for Wiring: Wire and cable shall be furnished and installed by the Contractor. All wire and cable shall be new soft drawn copper and shall conform to all the latest requirements of the National Electrical Code, IPCEA, and shall meet the specifications of the ASTM.
- D. Power Conductors: Provide conductors for all feeders and branch circuits as specified in Specification Section 260120.
- E. Motor Interlock Wiring: Interlock circuit wiring shall be No. 14 solid or stranded wire. Stranded wire only shall be used where wiring is used for flexible wiring harnesses. Stranded control wire shall be provided with crimp type spade terminators. Interlock circuit wiring shall be color-coded or numbered using an identical number on both ends of the conductor. Wire numbers shall be installed before conductors are pulled. Where motor interlock conductors are run in cable tray, furnish and install conductors or multi-conductor cable rated for use in cable trays per NEC articles 340 and/or 725.
- F. Automation Input/Output Wiring: Wiring serving inputs and outputs from the automation system shall be cables consisting of single or multiple twisted individually shielded pairs. Each pair shall have an independent shield with drain wire. Cables installed without conduit shall be plenum rated and comply with NEC article 725. Multi-conductor cable shall only be used where all the points are at a single location and for the same device (i.e., variable frequency drives, each individual motor starter). Single conductor cables shall be used for all temperature transmitters, pressure transmitters, flow meters, differential pressure switches, control valves and any other locations where the points are not grouped together at the same device. Where automation input/output wiring is run in cable tray furnish and install conductors or multi-conductor cable rated for use in cable trays per NEC articles 340 and/or 725. Conductors shall be minimum #18 wire gauge. All wires shall be continuous from outlet to outlet and there shall be no unnecessary slack in the conductors.
- G. Floor level network (FLN): Wiring serving communication trunks from the automation system shall be cables consisting of single twisted individually shielded pairs. Each pair shall have an independent shield with drain wire. Cables installed without conduit shall be plenum rated and comply with NEC article 725. Where automation input/output wiring is run in cable tray furnish and install conductors or multi-conductor cable rated for use in cable trays per NEC articles 340 and/or 725. Conductors shall be minimum #18 wire gauge.
- H. Splices: All splices, taps, and terminations shall be made at outlet, junction, or pull boxes. Wire to No.6 gauge shall be spliced using Scotchlok wire nuts. No Bakelite wire nuts shall be used. Wire No. 6 and larger shall be spliced using solderless connectors as manufactured by Penn Union Company. Splices No. 6 and larger shall be insulated by taping with plastic vinyl tape as manufactured by Minnesota Mining and Manufacturing Company. Splices shall not be permitted in automation input and output wiring without specific written authorization from the Engineer. If such a splice is approved, the location of the splice shall be clearly documented on the "As Built" drawings. Splices in automation wiring, if necessary, shall be made using Thomas & Betts STA-KON connectors installed per the manufacturer's directions to maintain NEMA specified voltage drops and wire retention forces.

- I. Pilot lights where shown or required will be the push-to-test type and will be provided with two spare bulbs per lamp.

2.5 JUNCTION BOXES, FITTINGS AND WIREWAYS

- A. Quality: All switch, pull, junction boxes, etc., shall be hot dipped galvanized or sherardized, concrete tight, with interlocking ring or multiple point locking devices. Connectors shall be three piece. Indentation fittings are not acceptable.
- B. Attaching: Boxes shall be attached by fasteners designed for the purpose and shall provide adequate mechanical strength for future maintenance.
- C. Size: Junction and pull boxes shall be minimum 4 inch square, or larger as required by NEC.
- D. Furnish and install at all control panel locations a NEMA 1 wire way system to bring cable into and out of the panel. Furnish 3 wire-ways at each panel location; one for tubing, one for Class 1 wiring, and 1 for Class 2 and Class 3 wiring.
- E. All wiring leaving the panel shall be separated by classification; i.e., Class 1 circuits shall not be run with Class 2 circuits, etc. Segregation shall be maintained inside the panel to the fullest extent possible. Where low voltage wires carrying low level AC and DC signals cross wires containing power and high level AC signals, the wires shall cross at a 90 degree angle.
- F. Wireway systems at locations where cables are to be run without conduit or in a cable tray shall consist of a connection to the control panel with a vertical extension to 8'0" or the pipe rack or cable tray level, whichever is higher. The vertical section shall terminate in a 90° fitting with a closure plate. The closure plate shall be provided with a conduit nipple with locknuts and bushings as a wire entry point into the square duct. The conduit nipple shall be 1 size smaller than the wireway it is associated with.
- G. Wireway systems at locations where cables are to be run in conduit shall consist of a horizontal section of wire way with a length equal to the control panel width and located above the control panel and connected to the control panel with 3 conduit nipples, locknuts, and bushings; one for tubing, one for Class 1 wiring and one for Class 2 and 3 wiring. Conduits for cable runs shall terminate on the wireway.
- H. The intent of the wireway configurations outlined above is to provide a method for adding input and output wiring to the control panel without having to drill directly into the electronics enclosure after the system is on line and running. The installation of the wireway shall be made with this consideration in mind.

2.6 SAFETY CIRCUITS

- A. All safety circuits shall be hard-wired circuits using standard snap acting electric or pneumatic switches as required by the function, and shall be totally independent of the DDC system controllers. Operation of safeties shall be independent of the position of any Hand-Off-Auto selector switches. This includes interlocks that return dampers and valves to some normal, fail-safe position when the system they are associated with shuts down. It is the intent of this paragraph that the systems have the capability to be operated manually complete with

safeties and fail safe interlocks even if the DDC system is off line. Software safeties will not be accepted.

2.7 HANGERS AND ANCHORS

- A. Where control system tubing is run on trapezes and/or hangers used by and or installed by other trades, supports for the trapezes shall be coordinated by all trades using the trapeze to assure that the anchor system is not overloaded and is sufficient for the load imposed including a margin of safety and seismic considerations. Under no circumstances shall a trapeze or hanger system installed by the electrical trades be used to support work by any other trade, nor shall the electrical trades use the trapezes installed by any of the other trades for the support of electrical equipment, all as required by the National Electric Code. Similarly, under no circumstances shall a trapeze or hanger system installed by the sprinkler trades be used to support work by any other trade, nor shall the sprinkler trades use the trapezes installed by any of the other trades for the support of sprinkler systems or equipment, all as required by NFPA 13, Standard for the Installation of Sprinkler Systems.
- B. Anchors to be loaded in tension for use in existing concrete structure and anchors loaded in tension and not cast in place shall be epoxy resin set anchors installed per the manufacturer's recommendations for technique, size, loading, embedment, etc. Where anchors are loaded in shear at these locations, suitably sized and installed wedge type anchors may be used.
- C. In all cases, anchor loading shall be based on hanger spacing, weight of the pipe to be supported when full and insulated, weight of any additional loads imposed upon the anchor, wind loading, seismic loading, quality of the material that the anchor is being installed in, etc. The contractor shall verify in the field that the anchors used and the materials that they are being installed in are suitable for the load imposed and shall bring any problems to the attention of the Owner's Representative in writing immediately and not proceed without direction from the Owner's representative.
- D. Wedge type anchors shall be Hilti Kwik Bolt II. Adhesive anchors shall be Hilti HVA.

2.8 SENSORS AND INPUT HARDWARE

- A. Field-Installed Temperature Sensors -Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.
 - 1. Thermistors - Precision thermistors may be used in applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degrees F cumulative. A/D conversion resolution error shall be kept to 0.1 degrees F. Total error for a thermistor circuit shall not exceed 0.5 degrees F.
 - 2. Resistance Temperature Detectors (RTDs) - Provide RTD sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs

are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degrees F.

3. Temperature Sensor Details

- a. Room Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor. Provide room temperature sensors with timed override button, setpoint adjustment of +/- 3 degrees (adjustable) from the centrally controlled set point, digital temperature display. Provide a communication port to central control panel. Room sensors shall be constructed for wall box mounting.
- b. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.
- c. Duct Averaging Type: Continuous averaging sensors shall be one foot in length for each 4 square feet of duct cross-sectional area, and a minimum length of 6 feet.
- d. Outside Air Type: Provide the sensing element on the building's north side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element. Signal transmitters shall be of NEMA 3R construction and rated for full range of ambient temperatures.

B. Output Hardware

1. Motorized Dampers

- a. Motorized Dampers shall be equal to Ruskin CD-60 with the following features: Nailor 1120, American Warming VC-27 or approved equal by Arrow, Penn, or Greenheck shall be equally acceptable.
- b. Motorized Dampers shall be:
 - 1) Rated per AMCA standard 500: Pressure drop rated in accordance with figure 5.3; leakage rated in accordance figure 5.5. Maximum pressure drop shall be rated for a 24"x24" test duct.
 - 2) Rated for up to 180 degrees F.
 - 3) Allowable velocity of 3000 FPM (48" - 60" long blades) and 4000FPM (max. 48" long blades) and differential pressure of 3.5" W.G.
 - 4) Maximum pressure drop at 3000 fpm shall not exceed 0.30" W.G.
 - 5) Maximum Leakage per Sq.Ft. at 1" W.G. differential pressure: 3.0 CFM for dampers 12" to 24" wide and 2.0 CFM for dampers greater than 24" wide.
 - 6) Damper assemblies in ductwork subject to above 3-inch water gauge static air pressure shall be constructed to meet SMACNA Seal Class "A" construction requirements.
 - 7) Opposed blades.

- 8) Frame - 5" x 1" x 16 gauge galvanized steel hat channel.
 - 9) Blades - Airfoil shaped, double skin galvanized steel construction of 14 gauge equivalent thickness, maximum 6" wide. Blade extensions may be used on top and/or bottom blades to meet damper size requirements without diminishing free area.
 - 10) Seals - Extruded vinyl blade edge seals and flexible metal compressible jamb seals. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F.
 - 11) Finish - Mill galvanized.
 - 12) 1/2" diameter x 2" long axles, cadmium plated steel (or hex or square).
 - 13) Stainless steel axle bushings.
 - 14) Blades securely attached to shaft.
 - 15) Linkage shall be concealed in frame and shall be plated steel bars with stainless steel pivots. Operating linkages shall be constructed to have a 2 to 1 safety factor when loaded with the maximum required damper operating force. Linkages shall be brass, bronze, galvanized steel, or stainless steel.
 - 16) Damper torque requirements shall not exceed 5 in-lbs per ft. for opposed blade dampers and 7 in-lbs per ft. for parallel blade dampers.
 - 17) Maximum single dampers section shall be 60" wide x 72" high.
 - 18) For multiple section dampers, each section shall be operated by a separate actuator.
 - 19) Mount actuators directly to a 1/2" diameter control shaft with outboard support bearing that extends 6" beyond the damper frame. For dampers in ducts with external insulation, provide support for bearing that supports the bearing outside insulation.
- c. Motorized damper actuators shall have the following features.
- 1) Actuators shall be equal to Belimo model AF24-SR.
 - 2) Actuators shall be connected to the dampers as shown in details on the drawings. Provide all needed linkages and materials for a complete operating damper.
 - 3) Actuators shall be factory mounted and connected to the damper section(s).
 - 4) Size all actuators for minimum of 130% of the torque required to operate the damper(s).
 - 5) Maximum time for full stroke or return of 135 seconds. The spring return running time shall be approximately 40 seconds.
 - 6) Each actuator shall have a minimum torque of 133 in-lbs.
 - 7) The actuator shall have spring return for fail-safe operation. During normal operation the actuator shall not work against the force of the spring.
 - 8) The actuator shall be powered by either 24 VAC or 24 VDC. Power consumption shall not exceed 6 watts. Actuator control shall be proportional by a 0 to 10 VDC or 4 to 20ma signal, with the addition of a 500 ohm resistor.

- 9) Actuator shall have built in overload protection to prevent damage to the actuator when the actuator or damper reaches its end position. End switches are not acceptable.
- 10) Actuator shall be UL listed and labeled.
- 11) Actuator shall be designed for a minimum 60,000 open-close cycles and 1000 spring return cycles.
- 12) Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable.
- 13) Spring return actuators shall be provided on all control dampers except terminal fan coil units, terminal VAV units, convectors, and unit heaters; unless indicated otherwise.
- 14) Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

PART 3 - EXECUTION

3.1 WIRING SYSTEM

- A. Install complete wiring system for electric and electronic control systems. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- B. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed.
 1. Wiring in the ceiling, attic and within wall cavities may be cable.
 2. Wiring to thermostats, temperature sensors, or other devices on walls without cavities shall be in wiremold (almond color). Other wiring shall be in conduit.
 3. Exposed wiring to rooftop mounted units, condensing units, and other units that are outside the building shall be in conduit.
- C. Low voltage control wiring and 24 VAC wiring can be run in the same conduit. Power wiring over 24 volts (i.e. 115 VAC or greater) must be in a separate conduit.

3.2 CONDUIT INSTALLATION

- A. Conduit bends shall be made with standard hickies of proper size; radius of bends to be at least 6 times the diameter of the conduit. Runs between outlets shall not contain more than the equivalent of three-quarter bends. Conduit runs shall be continuous from outlet to outlet, outlet to cabinet, etc.
- B. Conduits shall be installed with pitch toward outlet box wherever possible. All heavy wall conduits shall have two locknuts and a bushing at each termination outlet box, junction box, etc., except where terminated in a threaded hub. Fittings on electro-metallic tubing shall be compression type.

- C. A bushing shall be used where conduit enters a panel box. Bushing for No. 4 AWG or larger shall be insulated type with provisions for grounding as type "BL" made by O-Z Electric Company, or approved equal.
- D. All conduits shall be installed parallel or at right angles to the building walls or floors.
- E. Expansion fittings shall be provided at all conduits across the building expansion joints. Fittings shall be Type "AX" or "TX" as made by O-Z Electric Company, or approved equal. Provide copper bonding jumper at each expansion fitting.
- F. Exposed conduit shall be securely fastened in place on maximum 5 ft. intervals for ¾" through 2-1/2 inch nominal sizes. Supports may be one hole malleable straps or other approved devices. No perforated metal straps will be permitted.
- G. Pull boxes and junction boxes shall be installed where indicated on the drawings or where required to facilitate wire installation. Locate in conjunction with other trades so as to install without conflict with other materials or equipment.
- H. Care shall be used to avoid proximity to heat ducts and/or steam lines. Where crossings are unavoidable, conduit shall clear covering of line by at least six inches.
- I. All conduit for automation wiring shall be identified by painting junction box covers as follows: Voltages above 24 shall be blue and red, voltages at 24 or below shall be blue.

3.3 INSTALLATION OF CABLES

- A. Support cables installed in ceiling spaces every 5' from the building structure with J-hooks, bridal rings or other approved supports. Cabling shall not be attached to electrical conduits, suspended ceiling grid system including ceiling support wires, ducts, sprinkler systems, gas, water pipes, or other pipes, etc.
- B. Organize and group cables. Run through ceiling spaces following column lines. Do not install cable group runs diagonally across building.
- C. All wiring shall be installed in accordance with local code requirements.

3.4 PERFORMANCE VERIFICATION TESTING (PVT)

- A. The PVT shall demonstrate compliance of the control system work with the contract requirements. The PVT shall be performed by the Contractor. Cx Agent will not participate in any part of the PVT. If the project is phased, provide separate testing for each phase. The Commissioning (Functional Testing) will be coordinated with the Contractor and Cx Agent.
- B. Performance Verification Testing Plan – Contractor shall provide functional testing plan.
- C. PVT Sample Size - Test all primary air handling unit controllers unless otherwise directed. Twenty percent sample testing is allowed for identical controllers typical of terminal control like VAV boxes and fan coil units.

- D. Performance Verification Testing Checklist - Submit the following as a list with items checked off to the Engineer and Cx Agent for reference. Provide a detailed explanation for any items that are not completed or verified.
1. Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the Functional Testing is conducted).
 2. Verify HVAC motors operate below full-load amperage ratings.
 3. Verify all required control system components, wiring, and accessories are installed.
 4. Verify all control circuits operate at the proper voltage and are free from grounds or faults.
 5. Verify all required surge protection is installed.
 6. Verify the A/C Power Table specified in "CONTROLS SYSTEM OPERATORS MANUALS" is accurate.
 7. Verify each digital controller's programming is backed up.
 8. Verify all wiring, components, and panels are properly labeled.
 9. Verify all required points are programmed into devices.
 10. Verify all TAB work affecting controls is complete.
 11. Verify all valve and actuator zero and span adjustments are set properly.
 12. Verify all sensor readings are accurate and calibrated.
 13. Verify each control valve and actuator goes to normal position upon loss of power.
 14. Verify each controller works properly in stand-alone mode.
 15. Verify all safety controls and devices function properly, including freeze protection and interfaces with building fire alarm systems.
 16. Verify all electrical interlocks work properly.
 17. Verify the as-built (shop) control drawings are completed.
- E. Execution of Sequence of Operation - Demonstrate that the HVAC system operates properly through the complete sequence of operation.
- F. Performance Verification Testing Report - Upon successful completion of the PVT, submit a PVT Report to the Engineer and Cx Agent for reference. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.
- G. Commissioning (Functional Testing)
1. Once the PVT is complete, commissioning shall be performed as directed by Cx Agent.
 2. Functional Testing shall be performed prior to substantial completion. Time scheduled and coordinated by Contractor.

3.5 LABELING AND IDENTIFICATION

- A. Provide labeling and identification as specified in Specification Section 16075 and as described below.

- B. All wiring, tubing and cabling both inside and outside of control panels shall be labeled at both ends using Thomas and Betts EDP printable wire and cable markers using style WSL self-laminating vinyl. Input and output cables and wiring shall be labeled with the point number and the point description such as:

CPDPS005
Primary Heating Water
Pump #1 Proof of Operation

- C. Cable and wiring not specifically associated with an input or output shall be labeled with a number and a function description such as:

+120 VAC Power
Panel DP2 Ckt 1

PART 4 - EXECUTION

4.1 ROOFTOP UNIT (RTU-1,2,3) – VARIABLE AIR VOLUME WITH VAV BOXES

- A. Unit shall be furnished with factory-installed controller capable of executing the following sequence utilizing internal programming.
- B. Provide a networked DDC system for stand-alone control in compliance with the latest revision of the ASHRAE 135 BACnet standard. Include all programming, objects, and services required to meet the sequence of control. Provide BACnet communications between the DDC system and native BACnet devices furnished with HVAC equipment. All unit and system level controls shall be provided with BACnet MSTP communication protocol. Systems and equipment using a proprietary communications protocol shall be excluded from this bid.
1. Units shall be provided with a central touch screen control panel, located inside the office building, to manage and control the RTUs and all connected VAV boxes. Control panel and associated infrastructure (controllers, sensors, transducers, relays, etc) shall be of the same manufacturer as the RTU. Basis of design is Daikin iTouch Manager or equivalent.
 - a. User interface shall be icon and menu driven browser based control for easy operation
 - b. Users shall have access to view or manage schedules, alarms, trend information, setpoints, building configuration depending on the security level of the user.
 - c. User shall have ability to edit or delete system components depending on the security level of the user.
 - d. System shall have the ability to store Portable Document Format (PDF) files and display them through the user interface.
 - e. Provide with adapter bracket to mount control panel to an interior wall.

2. Control system shall automatically integrate to equipment and BACnet thermostats, equipment property pages shall be pre-configured for these devices.
 3. User shall have ability to view, acknowledge, or clear alarms.
 4. User shall have the ability to change all configuration parameters of the RTU unit controllers available through BACnet.
 5. User shall have the ability to change all configuration parameters of the VAV terminal units available through BACnet, including:
 - a. Min and max airflow setpoints
 - b. Zone heating or cooling setpoints
 - c. Min/Max allowable zone setpoint restrictions
 - d. Occupancy override time
 - e. Damper position override
 - f. Control parameters, including
 - 1) Stage timers
 - 2) Deadbands
 - 3) Flow coefficient
 - 4) Tuning parameters
- C. Occupied mode: Unit supply fan shall be energized and shall run continuously. The unit will modulate the supply fan as required to maintain the duct pressure set point.
1. Ventilation is supplied through the outdoor air damper. The minimum outside air damper position shall be adjustable. The unit controller will proportionally modulate the outside air dampers open and closed as the supply fan speed changes to provide a constant volume of fresh outside air.
 2. The RTU supply fan shall be shut off if smoke is detected at the return air smoke detector (where applicable – see RTU Schedule)
 3. Discharge air temperature shall be maintained at 55°F during the occupied mode by sequencing the cooling, heating and economizer dampers.
 - a. Cooling: In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
 - b. Heating: The heat pump will activate to serve as primary heat and will modulate the compressor to meet the discharge air temperature heating set point. If the heat pump capacity cannot satisfy the set point the supplemental SCR electric heat will operate as needed, in addition to heat pump operation, to maintain the heating discharge air set point.
 - 1) Defrost: Defrost will be activated when a factory mounted temperature sensor determines frost build up. During the defrost cycle the unit will reverse the indoor and outdoor coil operation to send hot gas to the

outdoor coil for defrost. The heating discharge air temperature set point will be maintained by the supplemental electric heat.

4. The unit shall operate in an economizer mode when the outside air enthalpy is lower than the return air enthalpy. Barometric exhaust air damper shall open to maintain space pressure. Outside air and return air dampers shall modulate to maintain supply air temperature set point.
 5. DDC controls shall provide a warm-up cycle which shall prevent the fresh air dampers from opening until the spaces have reached occupied temperature. Provide signal during warm-up cycle to VAV boxes to open the VAV primary air dampers.
- D. Unoccupied Mode: RTU supply fan shall run intermittently, outside air damper shall remain closed.
1. Unoccupied heating mode: RTU controls shall cycle supply fan and modulate gas heating to maintain setback temperature within the space. Energize the supply fan when the coldest zone falls to the setback temperature and stop supply fan when coldest zone rises to 3 °F above the setback temperature.
 2. Unoccupied cooling mode: Supply fan and compressors shall be cycled to maintain a setback temperature within the space. Outside air dampers shall remain closed.
- E. VAV Boxes – Electric Heat
1. VAV boxes shall operate with an individual VAV Terminal Unit Controller, space sensor and signals from RTU control panel for unoccupied and morning warm-up signals. Terminal Unit Controllers shall be factory installed in the VAV.
 - a. Controllers shall ship from the factory, pre-wired and configured for their specific application and zone. Zone specific tagging, min/max flow setpoints, primary inlet size, and reheat type shall be preprogrammed to ensure plug and play operation. Coordinate with VAV terminal unit manufacturer.
 - b. Unit controllers shall be capable of providing standalone zone control
 2. Cooling Mode - Space sensor shall signal the flow controller to modulate the terminal unit actuator as required to maintain space temperature. Set thermostat for 74°F. Minimum airflow in the cooling mode shall be set per minimum airflow in VAV schedule.
 3. Heating Mode - After terminal unit actuator has closed primary air to its minimum heating position, modulate electric SCR heating coil to maintain space temperature setpoint. Minimum airflow in the heating mode shall be the heating airflow scheduled.
 4. Morning Warm up - Send signal to fully open the VAV primary air dampers. Heating coil shall be under zone control.
 5. Unoccupied Mode – Heating coil shall be off. Minimum box airflow shall be 0 cfm.
 6. Alarms - Specific alarm values shown below; all shall be programmable with desired values:
 - a. Duct supply air temp: below 47°F or above 115°F
 - b. Space Temperature: below 65°F or above 80°F

7. Setpoints:
 - a. Occupied setpoints: 74°F cooling, 70°F heating
 - b. Unoccupied setpoints: 78°F cooling, 66°F heating

4.2 ROOFTOP UNIT (RTU-6) – VARIABLE AIR VOLUME WITH VAV BOXES

- A. Unit shall be furnished with factory-installed controller capable of executing the following sequence utilizing internal programming.
- B. Provide a networked DDC system for stand-alone control in compliance with the latest revision of the ASHRAE 135 BACnet standard. Include all programming, objects, and services required to meet the sequence of control. Provide BACnet communications between the DDC system and native BACnet devices furnished with HVAC equipment. All unit and system level controls shall be provided with BACnet MSTP communication protocol. Systems and equipment using a proprietary communications protocol shall be excluded from this bid.
 1. Unit shall be provided with a central touch screen control panel, located inside the operations building, to manage and control the RTU and all connected VAV boxes. Control panel and associated infrastructure (controllers, sensors, transducers, relays, etc) shall be of the same manufacturer as the RTU. Basis of design is Daikin iTouch Manager or equivalent.
 - a. User interface shall be icon and menu driven browser based control for easy operation
 - b. Users shall have access to view or manage schedules, alarms, trend information, setpoints, building configuration depending on the security level of the user.
 - c. User shall have ability to edit or delete system components depending on the security level of the user.
 - d. System shall have the ability to store Portable Document Format (PDF) files and display them through the user interface.
 - e. Provide with adapter bracket to mount control panel to an interior wall.
 2. Control system shall automatically integrate to equipment and BACnet thermostats, equipment property pages shall be pre-configured for these devices.
 3. User shall have ability to view, acknowledge, or clear alarms.
 4. User shall have the ability to change all configuration parameters of the RTU unit controllers available through BACnet.
 5. User shall have the ability to change all configuration parameters of the VAV terminal units available through BACnet, including:
 - a. Min and max airflow setpoints
 - b. Zone heating or cooling setpoints
 - c. Min/Max allowable zone setpoint restrictions

- d. Occupancy override time
 - e. Damper position override
 - f. Control parameters, including
 - 1) Stage timers
 - 2) Deadbands
 - 3) Flow coefficient
 - 4) Tuning parameters
- C. Occupied mode: Unit supply fan shall be energized and shall run continuously. The unit will modulate the supply fan as required to maintain the duct pressure set point.
- 1. Ventilation is supplied through the outdoor air damper. The minimum outside air damper position shall be adjustable. The unit controller will proportionally modulate the outside air dampers open and closed as the supply fan speed changes to provide a constant volume of fresh outside air.
 - 2. The RTU supply fan shall be shut off if smoke is detected at the return air smoke detector (where applicable – see RTU Schedule)
 - 3. Discharge air temperature shall be maintained at 55°F during the occupied mode by sequencing the cooling, heating and economizer dampers.
 - a. Cooling: In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
 - b. Heating: The heat pump will activate to serve as primary heat and will modulate the compressor to meet the discharge air temperature heating set point. If the heat pump capacity cannot satisfy the set point the supplemental modulating gas heat will operate as needed, in addition to heat pump operation, to maintain the heating discharge air set point.
 - 1) Defrost: Defrost will be activated when a factory mounted temperature sensor determines frost build up. During the defrost cycle the unit will reverse the indoor and outdoor coil operation to send hot gas to the outdoor coil for defrost. The heating discharge air temperature set point will be maintained by the supplemental gas heat.
 - 4. The unit shall operate in an economizer mode when the outside air enthalpy is lower than the return air enthalpy. Barometric exhaust air damper shall open to maintain space pressure. Outside air and return air dampers shall modulate to maintain supply air temperature set point.
 - 5. DDC controls shall provide a warm-up cycle which shall prevent the fresh air dampers from opening until the spaces have reached occupied temperature. Provide signal during warm-up cycle to VAV boxes to open the VAV primary air dampers.
- D. Unoccupied Mode: RTU supply fan shall run intermittently, outside air damper shall remain closed.

1. Unoccupied heating mode: RTU controls shall cycle supply fan and modulate gas heating to maintain setback temperature within the space. Energize the supply fan when the coldest zone falls to the setback temperature and stop supply fan when coldest zone rises to 3 °F above the setback temperature.
2. Unoccupied cooling mode: Supply fan and compressors shall be cycled to maintain a setback temperature within the space. Outside air dampers shall remain closed.

E. VAV Boxes – Electric Heat

1. VAV boxes shall operate with an individual VAV Terminal Unit Controller, space sensor and signals from RTU control panel for unoccupied and morning warm-up signals. Terminal Unit Controllers shall be factory installed in the VAV.
 - a. Controllers shall ship from the factory, pre-wired and configured for their specific application and zone. Zone specific tagging, min/max flow setpoints, primary inlet size, and reheat type shall be preprogrammed to ensure plug and play operation. Coordinate with VAV terminal unit manufacturer.
 - b. Unit controllers shall be capable of providing standalone zone control
2. Cooling Mode - Space sensor shall signal the flow controller to modulate the terminal unit actuator as required to maintain space temperature. Set thermostat for 74°F. Minimum airflow in the cooling mode shall be set per minimum airflow in VAV schedule.
3. Heating Mode - After terminal unit actuator has closed primary air to its minimum heating position, modulate electric SCR heating coil to maintain space temperature setpoint. Minimum airflow in the heating mode shall be the heating airflow scheduled.
4. Morning Warm up - Send signal to fully open the VAV primary air dampers. Heating coil shall be under zone control.
5. Unoccupied Mode – Heating coil shall be off. Minimum box airflow shall be 0 cfm.
6. Alarms - Specific alarm values shown below; all shall be programmable with desired values:
 - a. Duct supply air temp: below 47°F or above 115°F
 - b. Space Temperature: below 65°F or above 80°F
7. Setpoints:
 - a. Occupied setpoints: 74°F cooling, 70°F heating
 - b. Unoccupied setpoints: 78°F cooling, 66°F heating

4.3 EXHAUST

- A. The following exhaust fans in the Warehouse, Vehicle Storage, Wash Bays and Maintenance Bays shall be controlled by wall switch, temperature sensor and CO/NO2 sensor(s) and motorized damper at associated intake louver shall open. These fans are to be stand-alone digital controls. See plans and details for sequence of operations and wiring diagrams.
 1. EF-1,2,H,I,J.

- a. Provide combination carbon monoxide/nitrogen dioxide sensors as shown on plans. Gas sensors shall have a minimum coverage area of 7500 sq. ft with a 7 year warranty. Gas sensor shall have a life expectancy of 7 years. Sensors shall be Senva Model TGM-ACNS or approved equal.
- b. Each detected toxin (CO/NO2) shall each have a 'low' and 'high' level.
 - 1) CO low level: 35 ppm
 - 2) CO high level: 150 ppm, activate fan/damper relay
 - 3) NO2 low level: 1 ppm
 - 4) NO2 high level: 3ppm, activate fan/damper relay
- B. The following exhaust fans shall be interlocked with a motorized damper.
 - 1. EF-M shall be interlocked with MD-10. MD-10 shall open upon operation of EF-M; MD-10 shall close when EF-M is off.
 - 2. EF-N shall be interlocked with MD-11. MD-11 shall open upon operation of EF-N; MD-11 shall close when EF-N is off.
- C. The following exhaust fan shall be interlocked with FCU-3 and MD-9 and shall be energized upon operation of FCU-3.
 - 1. EF-K.
- D. The following exhaust fans shall be tied to the building timeclock and shall operate during occupied hours (adj):
 - 1. EF-A,B,C,D,E,F,G,L.
- 4.4 DUCTLESS SPLITS (DS-A,B)
 - A. Temperature control shall be by the integral controls in the unit and manufacturer-provided, wall mounted thermostat. Thermostat shall be 7-day programmable type.
 - B. Control wiring between the indoor unit and the outdoor condensing unit shall be work of this section (230960).
- 4.5 FAN COIL UNITS (FCU-1,2,3)
 - A. Temperature control shall be by the integral controls in the unit and manufacturer-provided, wall mounted thermostat. Thermostat shall be 7-day programmable type.
 - B. Control wiring between the indoor unit and the outdoor condensing unit shall be work of this section (230960).
 - 1. FCU-1 shall be interlocked with MD-4. MD-4 shall open upon operation of FCU-1; MD-4 shall close when FCU-1 is off.
 - 2. FCU-2 shall be interlocked with MD-5. MD-5 shall open upon operation of FCU-2; MD-5 shall close when FCU-2 is off.

3. FCU-3 shall be interlocked with MD-9. MD-9 shall open upon operation of FCU-3; MD-9 shall close when FCU-3 is off.

4.6 ELECTRIC UNIT HEATERS

- A. Fan and heat shall cycle per built in or wall mounted thermostat – see schedule on plans for type.

4.7 DESTRATIFICATION FAN (DSF-1,2,3,4,5)

- A. Fan shall be controlled by factory provided wall mounted controller; see section 230400 for more information.

4.8 TIME CLOCK

- A. Coordinate with electrical contractor in the provision of a time clock to control exhaust fans as listed above. This timeclock shall be provided by the electrical contractor and shall also control areas of lighting in the building.

- B. Time Clock program as follows:

MONDAY – FRIDAY	energized 5:30 AM to 5:30PM
SATURDAY	energized 8:30 AM to 12:30PM
SUNDAY	non-energized all day

4.9 SMOKE DETECTOR

- A. Furnish and install a duct mounted smoke detector in the return duct(s) of each rooftop unit. The smoke detector(s) shall shut the rooftop unit down when smoke is detected and energize a visual and audible annunciator device.
- B. Smoke detector shall be 120 VAC, self-contained as manufactured by Notifier. UL-268A listed.
- C. Duct detector housing, #DH400ACDCI, ionization type.
- D. Sampling tube, #ST-3, verify exact length of sampling tube before ordering.
- E. Remote annunciator panel, #APA451 for standalone duct detector applications.
 1. Piezo sounder.
 2. Alarm and power LED's.
 3. Single gangbox configuration.
 4. NFPA 90A compliance.

END OF SECTION 230960

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SECTION 260000 – BASIC ELECTRICAL REQUIREMENTS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Applicable provisions of Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between this section and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The word "Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- D. The submittal of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the requirements of local utility companies.
- B. All material furnished and work performed shall be in compliance with the latest applicable versions of the following codes, including local ordinances and amendments:

Kentucky Building Code	2018	2015
Kentucky Fire Alarm Code based on	2013 NFPA 72	2013
Kentucky Electrical Code based on	2023 NFPA 70	2023
OSHA Requirements		
Kentucky Commercial Energy Conservation code based on	2012 IECC	2012
Americans with Disabilities Act, Standards for Accessible Design		2010

- C. All electrical material used on this project must be UL listed and labeled.
- D. Where a conflict exists between the applicable codes, the plans and the specifications, the one shall be followed that results in the higher quality, most expensive and most complete installation.
- E. Install electrical equipment, devices and appurtenances in accordance with applicable standards and NECA 1-2010, "Standard Practice of Good Workmanship in Electrical Contracting."

1.3 PERMITS, LICENSES AND INSPECTION FEES

- A. This subcontractor shall obtain and pay the cost of all fees, permits or licenses that may be required for the performance of the work described herein.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying drawings plans (architectural, site, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on all. The intention of the drawings and specifications is to provide complete functioning systems in every respect. Furnish all material and equipment and perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install."
- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed. Obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all required materials. Conduit, wiring, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the drawings are schematic or diagrammatic. These details are not intended to show all materials, etc., required to achieve the arrangement shown. Adapt these details to the actual conditions of the job.
- E. Routing of conduit and location of equipment and other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.
- H. Coordinate arrangement, mounting and support of electrical equipment.
 - 1. To allow maximum possible headroom, unless specific mounting heights are indicated.
 - 2. To provide for ease of disconnecting equipment with minimum interference to other installations.
 - 3. To allow right-of-way for piping and conduit installed at slopes.
 - 4. So connecting raceway will be clear of obstructions and of the working and access space of other equipment.
- I. All mechanical, electrical, plumbing, fire protection, and HVAC work shall be coordinated by that contractor and any correction to any of the above work shall be at that contractor's expense.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, any discrepancies or omissions in any of the documents or any doubt as to their meaning, should be reported to the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.
- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. Before submitting a bid, visit the site and become acquainted with the conditions under which the work will be performed.
- B. Failure to fully understand the existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract.
- C. Work in electrical rooms impacts labs outside the work area and contractor shall understand all conditions.

1.7 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General and Special Conditions. Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Emails regarding submittals shall be sent to "submittals@sscengineering.com".
- D. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- E. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will

return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.

- F. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this Contractor.
- G. Shop drawings shall include the plan mark used on the plans.
- H. Equipment shop drawings shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- I. Submittals which do not provide the required information will be returned unchecked.
- J. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- K. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- L. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.
- M. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- N. Submit shop drawings on equipment as herein listed:
 - Panelboards
 - Safety switches
 - Enclosed circuit breakers
 - Dry type transformers
 - Motors and motor controls
 - Fuses
 - Lighting contactor
 - Conduit and boxes
 - Fire rated wall penetration sealer
 - Cable tray
 - Conductors
 - Wiring devices
 - Grounding equipment
 - Seismic restraints

Interior lighting
Exterior lighting
Emergency generator
Automatic transfer switch
Fire alarm system
HVAC smoke detection system
Video surveillance system
Sound system
Telephone equipment and wiring system
Data equipment and wiring system
Security system
Lighting dimmer control system
Time switches
Surge protection devices
Occupancy sensors
Photo controls

1.8 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- B. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 1. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- C. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
- D. Contractor shall also submit four (4) complete hard copy sets and one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:

1. Include a Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
2. Complete set of shop drawings.
3. Copies of all submittals.
4. Parts lists, wiring diagrams, piping diagrams, etc.
5. Manufacturers' operating and maintenance instructions.
6. Written operating and maintenance instructions for the system. This is a written version of Paragraph 1.9A above.
7. Copies of warranties.
8. Parts lists for each piece of equipment and name of local supplier.

1.9 TEMPORARY POWER

- A. For new facilities, the contractor's temporary electric service facilities shall include all required panels, switches, protective devices, conduit, wiring, receptacles, etc., required to extend service and adequately distribute light and power in accordance with NEC Article 590. Coordinate details of service and metering for job site and construction offices with local utility company. Energy charges shall be paid by the General Contractor.
- B. For existing facilities, the Owner's existing electrical distribution system shall be used for temporary power required for temporary lighting, 120 volt GFI receptacles and power to all construction equipment in accordance with NEC Article 590. Coordinate details of existing service and metering for job site and construction offices with local utility company. Energy charges shall be paid by the General Contractor. If portions of the existing building remain in use by the Owner, then the Owner shall pay the energy charges.
- C. Temporary lighting shall consist of protected luminaires symmetrically spaced to produce a minimum of 5 footcandles throughout the work areas.
- D. Temporary power panels shall be located on each floor of multi-story buildings. Panel area served shall not exceed 25,000 square feet. Each panel shall power 12-20A, 120V, quadraplex GFI receptacles. Locate quadraplex receptacles on each floor to permit work in all areas with extension cord not exceeding 100 feet in length.
- E. Stairs and other enclosed areas shall have adequate lighting.
- F. The service shall be available during all working hours and scheduled overtime hours and otherwise as necessary for security and safety purposes, with security lighting to be provided during all hours of darkness. All such facilities shall conform to all requirements of the National Electrical Code, the local utility, and all other governmental authorities having jurisdiction.
- G. Temporary power shall be provided for all construction trailers.
- H. Comply with NECA 200-2010, "Recommended Practice for Installing and Maintaining Temporary Electric Power at Construction Sites."

1.10 AS-BUILT RECORD DRAWINGS

- A. During construction, maintain a separate set of drawings at the jobsite to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of conduit and other concealed facilities shall be shown if and when they differ from the drawings. Underground conduit shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.11 GUARANTEE AND WARRANTY

- A. Guarantee and warrant equipment, materials, workmanship, installation, etc., for a period of one year in accordance with the General Conditions.
- B. During the guarantee period, make all required repairs and replacements, and provide necessary service, labor, tools, materials, parts, etc., at no additional cost to the Owner.

PART 2 - PRODUCTS**2.1 MATERIAL SUBSTITUTION**

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
- B. Equipment and materials are subject to the review and approval of the Engineer and Architect.
- C. Differences in cost involved in using an equally acceptable manufacturer shall be included in the bid. Contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.
- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.

PART 3 - EXECUTION**3.1 RESPONSIBILITY**

- A. Provide material, equipment, labor, services, supplies, etc., required to execute to completion work shown on the drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. Schedule work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. Schedule the work to coordinate with the construction.

3.2 COORDINATION OF TRADES

- A. Prior to the installation of any materials, review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. Work installed without coordinating with the other trades, which causes interferences, shall be removed and reworked, at no cost to the Owner.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall furnish and install all power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be furnished and installed by the Electrical Contractor. Unless noted otherwise, the control wiring shall be furnished and installed by the Contractor furnishing the controlled equipment.
- F. Unless noted otherwise, the Electrical Contractor shall furnish and install all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a part of a factory-assembled package. Heater elements for overload relays on magnetic motor starters (except the starters factory pre-wired with equipment) shall be sized, furnished and installed by the Electrical Contractor. Magnetic motor starters for mechanical equipment (except starters factory pre-wired with equipment such as chillers and packaged air conditioners) shall be furnished by the Electrical Contractor. Magnetic motor starters will be provided with:
 - 1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
 - 2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.
- G. Each Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized heater elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.
- H. Unless specifically noted otherwise, pilot controllers (aquastats, flow switches, pressure switches, etc.) shall be furnished and mounted by the Contractor furnishing the controlled equipment.
- I. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls and other structural components as they are constructed.
- J. Coordinate sleeve selection and application with firestopping specified in Division 7.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. Protect and preserve materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc. Provide enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of their negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. Plan, coordinate and schedule the work to satisfy the project schedule.
- B. Work shall be so arranged that electrical power and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.
- C. Interruptions shall be scheduled, and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.

3.5 DEMOLITION OF FACILITIES**A. GENERAL**

- 1. The demolition work shall consist of removal of electrical equipment and materials pertaining to the existing electrical systems as indicated on the drawings.
- 2. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. Field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.
- 3. Include in the bid all demolition work as required and as shown on the drawings.
- 4. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
- 5. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.
- 6. Equipment to be reused shall be disconnected, marked and protected where necessary.

B. EXISTING CONDITIONS

- 1. Exercise great caution when performing demolition work so as not to damage existing systems or items of work that are to remain. If the Contractor damages, destroys or removes an existing system which is to remain, the Contractor shall be responsible to repair or replace that system to its original condition.
- 2. Unless specifically stated otherwise on the drawings, where access to electrical items is required, provide the required access by removing ceiling, walls and other obstructions, cutting openings, etc., as required. Prior to cutting openings, outline the openings and obtain approval from the General Contractor and cut openings in the manner directed

by the Owner's Representative. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.

3. Provide repair and replacement of openings. Materials which are removed and are damaged or soiled shall be replaced with new materials. Ceilings, walls, conduits, etc., shall be properly repaired and restored to as close to the original condition as possible. Replacement of surface finish materials such as paint, ceiling tile, flooring materials, etc., shall be provided by the General Contractor.
4. Provide repair of floor openings and trenches. Floors shall be repaired to match the level and surface finish of the existing concrete.
5. Areas shall be repaired with materials matching those which have been removed.
6. Repair streets, sidewalks, and parking lots which have been altered by the work.

C. PROTECTION

1. During demolition operations, all persons and property shall be protected. Provide erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.
2. The work shall proceed in a manner to minimize any spread of dust, debris and flying particles, and so that any related effects of demolition do not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. DISPOSITION OF MATERIAL:

1. Those items of material and equipment to be removed and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

3.6 EQUIPMENT FURNISHED BY OTHERS

- A. Some pieces of equipment, as indicated on the drawings, will be furnished by the Owner and/or under other Divisions of these specifications. Provide electrical work as shown for connections to this equipment.
- B. Start-up of equipment furnished by the Owner or under other Divisions of these specifications shall be the responsibility of this Contractor under the Section assigned the responsibility to receive and set in place or to move and set in place.
- C. Warranties for equipment furnished shall be by the equipment manufacturer.

3.7 MAINTENANCE OF WORK AREAS

- A. This Contractor shall maintain the work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.

- B. Open ends of conduit, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.8 CLEANING AND CLEANUP

- A. Upon completion of this work, clean all panels, fixtures, and equipment. Leave all work in a finished, clean, and satisfactory working condition.

END OF SECTION 260000

SECTION 260010 – BASIC ELECTRICAL MATERIALS AND METHODS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260000 - Basic Electrical Requirements.

1.2 SCOPE OF WORK

- A. This section supplements all sections of this Division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems.

1.3 QUALITY ASSURANCE

- A. Electrical work including, but not limited to, installation, materials, equipment and wiring methods, shall comply with the applicable National Electrical Code, NFPA 70.
- B. Equipment and materials shall comply with the applicable requirements of the following:
 - 1. National Electrical Manufacturer Association (NEMA).
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. American National Standards Institute (ANSI).
 - 4. National Electrical Safety Code (ANSI Standard C2).
 - 5. Underwriters Laboratories (UL).
 - 6. National Electrical Contractors Association (NECA).
- C. Comply with NECA 1-2015, "Standard Practice of Good Workmanship in Electrical Contracting."

PART 2 - PRODUCTS**2.1 Provide products, components and materials which are listed and labeled by Underwriters Laboratories (UL) Test.****2.2 EQUIPMENT IDENTIFICATION LABELS**

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label. Labels shall be vinyl cloth with permanent adhesive and black text on orange field, 1"H x 12"W.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

3.1 Install equipment and materials in a neat and workmanlike manner and align, level, and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance and repair.

3.2 SUPPORTS

- A. Provide the design, fabrication, and erection of supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment. Provide members welded to structural members equal to the specification for the main structural member.
- B. Provide "simple beam" type framing with end connections welded or bolted for shear loads. Use cantilevers only when detailed or specifically approved by the Engineer. The Engineer's approval is required for location of supplementary framing.
- C. Design framing members for their actual loads, with allowable stresses specified by AISC, without excessive deflection and with consideration for rigidity under vibration, in accordance with standard structural practices.
- D. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3.3 WIRING DEVICE LOCATION

- A. Position of Outlets: Center all outlets with regard to paneling, furring and trim. Symmetrically arrange outlets in the room. Satisfactorily correct outlets improperly located or installed. Repair or replace damaged finishes. Set outlets plumb and extend to the finished surface of the wall, ceiling, or floor without projecting beyond same. Install symmetrically all receptacles, switches, and outlets shown on the trim or casework. Where necessary set the long dimension of the plate horizontal, or ganged in tandem.
- B. Mounting heights, to center of box above finished floor, shall be as follows, unless otherwise indicated. Other mounting heights are indicated on the drawings by detail or by a plus dimension shown adjacent to the symbol:

Switches	46 inches
Receptacles and similar devices	18 inches
Receptacles in mechanical rooms	46 inches
Motor controllers and disconnect switches	60 inches to top
Panelboards	72 inches to top
Exterior WP convenience outlets	24 inches above grade
Voice/Data outlets	18 inches
Wall voice outlets	46 inches
Television outlets	18 inches
Push buttons	46 inches
Fire alarm manual station	46 inches

Fire alarm, Audio/Visual device (wall mount) Lower of 82 inches above floor or 6 inches below ceiling.

- C. Contractor shall review Architectural Elevations prior to rough-in to ensure coordinating heights and locations of devices with casework, equipment or shelving. Devices shall not be installed behind casework or within cabinets unless specifically noted.

3.4 IDENTIFICATION

A. General

1. All electrical equipment and devices shall be identified by nameplates or labels.
2. Nameplates - Shall be 4" x 1" x 1/8" thick white core, black face, plastic with engraved letters. Attachment to equipment shall be done by means of screws.
 - a. Nameplates shall be used for all major equipment such as switchboards, motor panelboards, motor control centers, transformers, panelboards (lighting, power and auxiliary) on each switch and starter in each panelboard and motor control center, disconnect switches, relays/contactors, loose mounted motor starters, and on control panels serving fire alarm, security and public address system and motor circuits.
3. Labels (Stencils) - Shall be Brady or Westline and shall be color coded in accordance with ASA-Z34-1-53 "SAFETY COLOR CODE" to include system voltage, abbreviations of service, etc. For example: "480V", "Telephone", "Security", "Intercom", "Emergency", "120/208V", etc.
 - a. In general, all exposed feeders, conduits, raceways, pull boxes, and junction boxes shall be identified.
 - b. For conduit systems installed for future wiring installations, all conduits and pull boxes, both exposed and above ceiling, shall be identified.
 - c. Labels shall be used on all bare or smooth painted surfaces. For rough textured surfaces, such as wrinkle painted surfaces or plastic materials where sticking labels would not be permanent, stencils or screwed on letters shall be used.
4. Label all low voltage wiring at both ends with Brady tags. Identify data and telephone cables by cable number and document on As-Built documents.

B. Equipment Identification

1. Panelboard - Nameplate shall designate panel number, upstream panel and voltage. Nameplate shall be mounted on the inside of panel door when the panel is located in finished areas and on the front of door when located in mechanical equipment rooms; typewritten branch circuit connection sheet shall be inserted within the panelboard manufacturer's card holder.
2. Disconnect Switches and Motor Starters - Nameplates shall describe the equipment to be controlled and power circuit number.
3. Pushbutton Stations - Label shall identify the equipment controlled.

4. Transformers - Nameplate shall identify the equipment by plan designation, primary and secondary voltages, and KVA rating.
5. Auxiliary System Equipment - The control cabinets for auxiliary systems, such as fire alarm, P.A., intercom, program, etc., shall be identified with nameplate describing the system by designation, power circuit and voltage.
6. Fusible Switches - In addition to the nameplate, there shall be labeled on the inside of switch door, the fuse size required for equipment served.
7. Junction and Pull Boxes - Identify the function of the box such as "208 volt," "Telephone," "Fire Alarm," etc., with nameplates.

C. Raceway Identification

1. In general, all exposed feeder conduits, wireways, etc., shall be identified. Branch circuit designations shall be made only after the load balancing of the panelboards has been completed and shall be approved by Owner's representative. In general, designations shall include the area name and lighting type (e.g., Down Lights).
2. The identification labels shall be located at intervals of 50 feet or less and at every point where a conduit or raceway is entering and leaving a room.

D. Device Circuit Identification

1. Receptacles connected to emergency power shall be identified by panel name and circuit number, with labels adhered to the device cover plate.
2. Receptacles connected to normal power shall be identified by panel name and circuit number, with labels adhered to the device cover plate.

3.5 TEST

- A. Provide the tests as outlined hereinafter and other tests necessary to establish the adequacy, quality, safety, completed status and suitable operation of each system.
- B. Ground Rod Test: Immediately after installation, test driven grounds and counterpoises with a Ground Resistance Direct-Reading Single-Test Megger, utilizing the AC Fall-of-Potential Method and two reference electrodes five (5) feet deep. Disconnect the ground rod to be tested from other ground systems at the time of testing. The ground resistance for the electrical service shall be 15 ohms or less. Submit the results, date of test, and soil conditions, to the Engineer in writing, immediately after testing.
- C. Emergency Responder Radio Coverage Test
 1. Contractor shall provide a radio signal strength and coverage test using spectrum analyzers to verify the building has adequate Emergency Responder Radio coverage in accordance with IFC 510. The Contractor shall coordinate timing of the test to occur near the end of the construction process after all steel, framing, concrete, windows, roof, etc., are complete, but early enough to allow owner to address any potential deficiencies prior to final completion of the project. Any deficiencies in coverage shall be immediately reported to the owners, engineer and architect.

- D. Balance phase currents of all distribution panels and branch circuit panels within plus or minus 10 percent variation between average phase current and measured individual phase currents.
- E. Written test record shall be supplied to the Owner to show compliance with governing codes for grounding continuity.
- F. Final Corrections: Correct promptly any failure or defects revealed by these tests as determined by the Engineer. Reconduct tests on these corrected items as directed by the Engineer.

3.6 ALTERATIONS

- A. The Owner intends to make continued use of existing facilities during the construction period. Utilities and services to existing facilities shall not be interrupted without the Owner's approval. Organize the work as to cause a minimum of interference with the normal routine activities of the facilities. Interruptions shall be scheduled at the convenience of the Owner.
- B. Remove, cap and/or relocate equipment, outlets, conduit, wire, etc., as shown and specified on drawings. Examine all existing walls designated for removal, to determine the conduit and the wiring that will require capping and/or removal, whether or not such conditions are indicated on the drawings.
- C. Lighting fixtures, switches, receptacles, telephone outlets, fire alarm outlets, special outlets, etc., which are shown on the demolition plans shall be removed.
- D. Concealed conduit for circuits which are partially or completely abandoned may remain in place. Exposed conduit for abandoned circuits shall be removed unless otherwise noted.
- E. Wiring for existing circuits which must be re-routed, or which are partially abandoned, shall be reconnected to service the remaining outlets on the circuit.
- F. Wiring for a circuit which is to be abandoned shall be removed back to the panel which supplied the circuit.
- G. Refer also to specification 260000 for demolition requirements.

3.7 CONCRETE WORK

- A. Provide concrete work for electrical equipment as follows:
 - 1. Nominal 4" concrete pads with chamfered edges and corners for switchboards, dry-type transformers, motor control centers, VFDs, ATSeS and floor mounted panelboards. Concrete bases shall extend 1" beyond the equipment footprint unless specified otherwise.
 - 2. Concrete base for free-standing exterior lighting equipment, including parking lot light poles, walk lighting, flood lights and other work as indicated on the drawings.
 - 3. Provide concrete pad for utility transformer in accordance with utility requirements.
 - 4. Provide concrete pad for exterior genset in accordance with plan details.
 - 5. Concrete work shall comply with the requirements of Division 3. Minimum concrete strength at 28 days shall be 4000 psi for interior and 4,500 psi for exterior locations. Provide reinforcing steel per ACI standards.

6. Equipment pad size shall include required edge spacing for anchor bolts and seismic forces. Reinforcing shall be designed in accordance with ASHRAE Practical Guide to Seismic Restraint or designed by a structural engineer.
7. Concrete pads shall be designed for a minimum of 2'-6" between pads for access. If this minimum spacing can not be met, then provide continuous pad in that area.

3.8 CUTTING AND PATCHING

- A. Provide openings for conduit, by means of sleeves.
- B. Provide cutting required for conduits if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls or footings be cut without first obtaining written permission from the Structural Engineer.
- C. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., obtain the Owner's approval in advance of the cutting and patching.
- D. Before cutting or drilling holes in floors, verify the location of reinforcing steel bars and embedded electrical conduits to avoid cutting same. X-ray floors where necessary to verify such locations. Contact the Engineer before proceeding with cutting if such obstructions interfere with the locations of planned holes.

3.9 ROOF OPENINGS

- A. Provide cutting, patching and flashing of roof for conduits through roof. Roof cutting and patching shall be coordinated with the roof installer. The original roof warranty shall be maintained.

3.10 PAINTING

- A. Electrical equipment shall be factory finished standard color as furnished by the manufacturer. Scratches shall be touched up in the field after equipment is installed with paint which matches the original color.

3.11 EXCAVATION

- A. Excavate, as necessary, for underground conduit, etc.
- B. Material to be excavated shall be non-classified and shall include all earth or other materials encountered.
- C. Unless otherwise shown, provide separate trenches for each utility. Install all conduit in open trench.
- D. Excavation of trenches from surface to top of conduit shall be kept to a minimum but shall be of sufficient width for proper installation of the work. Provide ample excavation under and around all conduit joints to permit proper installation of connectors.
- E. Excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be

securely held by bracing or sheeting, which shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.

- F. Grading in the area of the excavation will be such that it shall prevent surface water from flowing into the excavated trench. Do not install conduit in water.
- G. Where underground conduits cross, the trench of the lower conduit shall be backfilled with sharp sand, well tamped, to provide bed for higher conduit. Lines which run parallel and at different levels shall be adequately separated to provide firm bedding for the conduits.

3.12 BACKFILLING

- A. Excavations shall be promptly backfilled.
- B. Trenches for conduit, etc., shall be backfilled for a depth of at least one (1) foot over the top of conduit with minus. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed thoroughly compacted to prevent lateral displacement.
- C. Backfill from 1'-0" above the top of the conduit to 6" below grade shall be clean on-site materials. Rocks or other materials over 3/4" shall be removed. The last 6" of backfill shall be topsoil in planted areas, or earth in non-planted areas, or other materials as required by the architect, civil or site engineer when passing below asphalted or concrete areas. Place earth material in 6" to 8" maximum thickness layers and compact to dry density of at least 95% of maximum dry density as measured by Modified Proctor.
- D. Backfill from 1'-0" above the top of the conduit to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of 1/2".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, re-compacted, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, air dry or scarify and re-compact.
- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 260010

SECTION 260025 – SEISMIC RESTRAINTS**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Provide seismic restraints as indicated for each type of equipment and for conduit systems.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section:
 - 1. Section 260000 - Basic Electrical Requirements
 - 2. Section 260010 - Basic Electrical Material and Methods
 - 3. Section 260190 - Supporting Devices

1.3 DEFINITIONS

- A. IBC: International Building Code.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading (Wherever loads are indicated, they shall apply only to outdoor equipment). Basic Wind Speed: 250 mph, exposure C.
- B. Seismic-Restraint Loading
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Seismic Occupancy Category as defined in 2009 IBC Table 1604.5: II.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 20.3%
 - 4. Design Spectral Response Acceleration at 1-Second Period: 12.6%
 - 5. Seismic Design Category: C

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260000.
- B. Submit manufacturer's installation instructions under provisions of Section 260000.
- C. Indicate seismic restraint locations including both lateral and transverse bracing on each shop drawings and described on product data. Indicate each restraint type as described on product data.
- D. Product Data: For the following:
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

- a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
2. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind (for outdoor equipment) forces required to select seismic and wind (for outdoor equipment) restraints.
 - 1) Coordinate design calculations with wind load calculations required for equipment mounted outdoors.
 - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - c. Seismic and Wind-Restraint Details:
 - 1) Design Analysis: To support selection and arrangement of seismic and/or wind restraints. Include calculations of combined tensile and shear loads.
 - 2) Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - 3) Coordinate seismic-restraint details with wind-restraint details required for equipment mounted outdoors.
 - 4) Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
3. Coordination Drawings: Show coordination of seismic bracing for conduit and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

PART 2 - PRODUCT

2.1 SEISMIC RESTRAINT

- A. All seismic restraint materials shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

- B. Seismic control products have been based on Mason Industries. Equivalent products by other manufacturers will be considered. Contractor shall have the following responsibilities:
1. Determine seismic restraint sizes and locations.
 2. Provide conduit and equipment seismic restraints as scheduled or specified.
 3. Provide installation instructions and drawings.
 4. Provide calculations to determine restraint loads resulting from seismic forces presented in the applicable International Building Code, governing codes, and project seismic requirements. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
- C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- D. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type. Minimum length of eight times diameter.
- E. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene or low dynamic stiffness natural rubber, with a flat washer face. Maximum 1/4 inch air gap, and minimum 1/4 inch thick resilient cushion.
- F. Specification SC: Restraint Cables:
1. ASTM A 603 galvanized for interior locations and ASTM A 492 stainless for outdoor locations -steel cables with end connections made of galvanized/stainless steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Accessories shall be the same material as the cable. Mason Industries, Type SCB Seismic Slack Cable Brace and Type SRC Seismic Rod Clamps.
 2. Strut System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels (struts), 1-5/8 inches wide, in varying lengths and combinations to meet load capacities, with accessories for attachment to braced component at one end and to building structure at the other end and other matching components; and rated in tension, compression, and torsion forces. 12 gage channels unless otherwise indicated in the approved submittals. Cooper B-Line model B22 strut systems, pipe hangers, and accessories.
- G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Mason Industries Type SRC Seismic Rod Clamps or B Line SC-228 or SC-UB Hanger Rod Stiffener.
- H. Specification SG: Seismic Grommets. Resilient Isolation Washers and Bushings. One-piece, molded, oil- and water-resistant neoprene or low dynamic stiffness natural rubber, with a flat washer face. The grommets shall be used with a steel washer between the bolt head (or nut if studs are used) and the grommet face. All anchor bolts shall be tightened until there is

obvious grommet distortion and the bolt is torqued to 80% of allowable. In no case, shall the anchor bolt torque be less than 50% of the allowable. Mason Industries, Inc. Type HG.

- I. Specification SFC: Lay in ceiling fixture support clip designed to prevent a light fixture from lifting out of the ceiling grid during a seismic or hurricane event. Fit round or rectangular head tee bar. Complies with National Electric Code Article 410.36 as a means of support for a light fixture. Painted finish. Erico - Caddy Clip model SFCLT, or equivalent by Alfex Inc or Electri-Flex Co.
- J. Specification SAB: Seismic Anchor Bolts.
 - 1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. Mason Industries, Inc. Type SAB.
 - 2. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Mason Industries, Inc. Type SAA.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Color-code or otherwise mark vibration isolation and seismic/wind control devices to indicate capacity range.
 - 2. All interior hardware shall be galvanized. All exterior hardware shall be stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Conduits Supports: Secure conduits to trapeze member with clamps approved for application.

- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- B. Conduit Restraints
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports and longitudinal supports at no more than the maximum of spacing indicated on the drawings or the local building code.
 - 3. Brace a change of direction as indicated on the drawings or the local building code.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 percent. Single sided "C" beam clamps shall not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.
- E. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Drilled-in Anchors
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or

drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in conduit where they cross seismic or expansion joints, where adjacent sections are supported by different structural elements, and where the connections terminate on equipment that is anchored to a different structural element from the one supporting the conduit as they approach equipment. Expansion and deflection fittings shall be equivalent to O-Z / Gedney type AXB, TX (with BJ bonding jumper), or DX, as applicable.

END OF SECTION 260025

SECTION 260055 – SHORT-CIRCUIT / SELECTIVE COORDINATION STUDY**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by A Licensed Professional Electrical Engineer.
- B. The scope of the short-circuit study shall encompass the entire electrical distribution system up to the utility furnished transformer. This includes any generator or transfers switches.
- C. The scope of the selective coordination study is limited to the life-safety branch of the emergency system including the EPS (Emergency Power Supply), EPSS (Emergency Power Supply System) and the upstream protective device feeding normal power to the EPPS.
- D. The scope of the studies shall include new distribution equipment installed by Electrical Contractor under this contract.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 - Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 - Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 4. ANSI C 37.41 - Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code, latest edition
 - 2. NFPA 70E - Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS FOR REVIEW / APPROVAL

- A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.5 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit and protective device coordination studies shall be summarized in a final report. Electronic PDF copies of the report shall be provided.
- B. The report shall include the following sections:
 - 1. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
 - 2. Short-Circuit Methodology Analysis Results and Recommendations
 - 3. Short-Circuit Device Evaluation Table
 - 4. Protective Device Coordination Methodology Analysis Results and Recommendations
 - 5. Protective Device Settings Table
 - 6. Time-Current Coordination Graphs and Recommendations
 - 7. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.6 QUALIFICATIONS

- A. The short-circuit and protective device coordination studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The calculations shall be signed and sealed by a registered professional engineer of the state in which the project occurs.

1.7 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program or equivalent from ETAP.

PART 2 - PRODUCT

2.1 STUDIES

- A. The contractor shall furnish a short-circuit and protective device coordination study. All studies to be prepared by the Licensed Professional Electrical Engineer.

2.2 DATA

- A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit and protective device coordination studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT ANALYSIS

- A. Transformer design impedances shall be used when test impedances are not available.
- B. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
 - 4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
 - 5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
 - 6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
- C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.
- D. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses

3. The electrical contractor shall notify the Engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title with descriptive device names.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 1. Electric utility's overcurrent protective device
 2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Medium voltage conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Provide the following:
 1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
 2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
6. The contractor shall notify the Engineer in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

PART 3 - EXECUTION**3.1 FIELD ADJUSTMENT**

- A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the Electrical Contractor.
- B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. The Contractor shall notify the Engineer in writing of any required major equipment modifications.

END OF SECTION 260055

SECTION 260060 – ELECTRICAL SERVICE**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section covers the electrical service from local utility.
- B. Service shall be as follows:
 - 1. Pad mount transformer.

1.2 RELATED SECTIONS

- A. Refer to other sections for conductors, switchboards, and raceways, fittings and boxes.

1.3 UTILITY SERVICE

- A. Verify all details relative to the Utility Company's installation and termination requirements. Furnish and install all such material required by the Utility Company.
- B. Each building's electrical service shall be 480/277 volts, 3 phase, 4 wire.
- C. The Utility is Taylor County Rural Electric Cooperative Corporation.

PART 2 - PRODUCTS – NOT USED**PART 3 - EXECUTION****3.1 PAD MOUNTED TRANSFORMER SERVICE**

- A. Electrical Contractor shall:
 - 1. Furnish and install underground primary conduit from the transformer pad to a location at the property line that is determined by the Utility. The conduit shall be 4" schedule 40 PVC at a minimum depth of three (3) feet and shall contain a pull tape.
 - 2. Obtain the transformer pad from the Utility, transport it to the site, and set it in place. At the contractor's option, they may pour a pad (at the site) which conforms to the Utility specifications.
 - 3. Furnish and install the secondary feeders from the pad-mount transformer to the service entrance switchboard.
 - 4. Furnish and install the CT/PT enclosure, meter enclosure and conduit from the current transformers to the meter enclosure, as required by the utility. Install the Utility-furnished current transformers, metering wire harness, and potential transformers.
 - 5. Furnish and install meter ground (including conductors, rods and connections).
- B. The Utility shall:

1. Furnish and install the primary cables in the contractor-provided underground primary conduit.
2. Furnish and install the pad-mounted transformer.
3. Make all terminations inside the transformer.
4. Furnish the current transformers, metering wire harness, and potential transformers to the Electrical Contractor.
5. Furnish and install the meter.

END OF SECTION 260060

SECTION 260070 – ELECTRICAL CONNECTIONS FOR EQUIPMENT**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section covers electrical connections to equipment.

1.2 EQUIPMENT CONNECTIONS

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Refer to drawings for additional requirements.
- C. Applications of electrical power connections specified in this section include the following:
 - 1. From electrical source to motor starters/VFDs.
 - 2. From motor starters/VFDs to motors.
 - 3. From electrical source to equipment with pre-wired control panels.
- D. Provide electrical connections for equipment, specified in Division 21, 22, & 23 and in other Division 26 sections.
- E. Provide motor starters and controllers, not furnished as part of equipment.
- F. Refer to Motor and Equipment Schedule on drawings and Division 21, 22, & 23 sections for motor starters and controllers furnished with equipment.
- G. Provide disconnect switches and junction boxes required for connecting motors and other electrical units of equipment.
- H. Variable Frequency Drives (VFD) will be furnished under Division 22 & 23. Install VFDs and provide wiring and connections. Include wiring between VFD and safety switch to shut down VFD when safety switch is turned off and circuit is open.
- I. Provide electrical identification for wire/cable conductors.
- J. Provide raceways and wires/cables required for connecting motors and other electrical units of equipment.
- K. Temperature control system wiring will be provided under Division 23.
- L. Provide electrical work for kitchen equipment as described herein, and as indicated on the drawings.
- M. Provide electrical work for motorized shades as described in Architectural plans and in Division 12. [Designer Note – Coordinate if low voltage or line voltage for motorized shades. Request from the architect their cutsheets of the specified system or a go-by from the architect for reference for electrical connections to indicate on plans. Multiple 120V circuit connections at each window and/or multiple feeds of low voltage may be required.]

- N. Provide electrical work for motorized doors and electrified door hardware as described in Division 8.
- O. Refer to sections of other divisions for specific individual equipment power requirements requiring electrical connections.

1.3 QUALITY ASSURANCE

- A. ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
- B. U.L. Compliance: Comply with U.L. Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are U.L. listed and labeled.
- C. Comply with NFPA 70 "National Electrical Code" for components and installation.

PART 2 - PRODUCTS

- 2.1 Provide products, components and materials which are listed and labeled by UL.

PART 3 - EXECUTION**3.1 ELECTRICAL WORK FOR KITCHEN EQUIPMENT**

- A. Provide all material and labor to install the electrical service and systems as required to operate the food service equipment. Make the final connections from the rough-in points to the connection points on the food service equipment.
- B. Provide all wire, junction boxes, convenience outlets, switches, disconnects, starters, receptacles and pull boxes not built into the equipment.
- C. Mount all disposer switches or control panels and wire switches, control panels and solenoid valves.
- D. Mount and wire extra cooler/freezer lights shipped loose with the cabinets.
- E. Provide all interconnecting wiring between compressors, condensers, evaporators, door heaters, heated vents, defrost heaters, lights, heat tape, switches, controls and disconnects on all walk-in cooler/freezer units.
- F. Provide interconnecting wiring between the exhaust hood fire suppression system and the building fire alarm system.
- G. Provide heat tape on all freezer condensate drain lines as required.
- H. Provide wiring to the make-up air unit. See hood drawings and/or HVAC drawings for locations and capacities. Provide motor starters, disconnects and furnish and install all fan and make-up air unit control and interlock wiring.

- I. Furnish and install electrical contactors or shunt trip breakers as required on electrical cooking equipment and interwire from the micro switch furnished with the fire system to the contactors or breakers so as to shut down the electrical power to the cooking equipment should the fire system discharge.
- J. Install remote light fixtures and ballasts furnished by the kitchen equipment supplier on kitchen/serving equipment as required. Interwire to light fixtures and remote switches on equipment and make final connections to units.

3.2 INSPECTION

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.3 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Install electrical connections as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices and complying with applicable requirements of U.L., NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Coordinate with other work, including wire/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating than, the electrical insulation rating of those conductors being spliced.
- E. Prepare cables and wires by cutting and stripping covering armor, jacket and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- F. Trim cables and wires as short as practicable and neatly arrange routing to facilitate inspections, testing and maintenance.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with torqueing values contained in U.L.'s 486A.

- H. Provide flexible conduit for motor connections and other electrical equipment connections, where subject to movement and vibration.
- I. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:
 - 1. Exterior location
 - 2. Moist or humid atmosphere where condensate can be expected to accumulate
 - 3. Corrosive atmosphere
 - 4. Water spray
 - 5. Dripping oil, grease or water
 - 6. Kitchens or dishwash areas
- J. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 26, Sections 260010 and 260120, Part 3.4. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.4 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 260070

SECTION 260110 – RACEWAYS, FITTINGS AND BOXES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260113 – Surface Metal Raceway

1.2 SUMMARY

- A. This section includes raceways, fittings and outlet boxes.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 “National Electrical Code” for components and installation.
- B. Comply with NECA 101, “Standard for Installing Steel Conduit (Rigid, IMC, EMT).”
- C. Comply with NECA 111, “Standard for Installing Non Metallic Raceways (RNC, ENT and LFNC).”
- D. Comply with NECA 120, “Standard for Installing Armored Cable (Type AC) and Metal Clad Cable (Type MC).”
- E. Comply with NECA 605, “Recommended Practice for Installing Underground Nonmetallic Utility Duct.”

1.4 SUBMITTALS

- A. Submit data sheet for all fire stopping materials.
- B. Submit information on raceways, conduits, boxes and wireways.

PART 2 - PRODUCTS**2.1 RACEWAYS (Raceways shall be new and shall bear the UL label)**

- A. Electrical Metallic Tubing: Shall be cold rolled welded steel conduit, galvanized on both the outside and inside. Connectors and couplings shall be steel alloy. Setscrew connectors and couplings are approved for indoor exposed or concealed (but not encased in concrete or masonry) work only. Gland compression connectors and couplings are approved for all locations. Indenter type connectors and couplings are not approved. Connectors up to and including size 1-1/2" shall be with insulated throat. Connectors shall be terminated with a bonding type locknut and for conduit sizes 2" and larger, a plastic insulated bushing. Threaded steel insulated grounding bushings having solderless lugs shall be used where required. Comply with ANSI C80.3. Connectors shall be steel; die-cast is not acceptable.
- B. Intermediate Metal Conduit (IMC): Shall be zinc-coated steel tubing. Comply with ANSI C80.6.

- C. Rigid Steel Conduit: Shall be zinc-coated rigid steel conduit and conduit fittings. Comply with ANSI C80.1 and UL 6. Couplings and fittings shall be of the threaded type. Threadless fittings shall be used only when specific approval is given by the engineer.
- D. Flexible Metallic Conduit: Shall be zinc-coated steel, single strip type, UL listed. Use Anaconda "Sealtite" flexible, liquid-tight conduit in damp or wet locations.
- E. Rigid PVC Conduit: Shall be heavy wall polyvinyl chloride conduit, Type 40 (NEMA EPC-40-PVC, Type II/III). Comply with NEMA TC-2.
- F. Wireway: Shall be constructed of code gauge steel and shall be in accordance with Underwriters Laboratories Standard UL-870 for Wireways, Auxiliary Gutters and Associated Fittings. Wireway shall be lay-in type (no cross bars or straps) with hinged cover. Indoor wireway shall be constructed with knockouts. Outdoor wireway shall be raintight with no knockouts. Sheet metal parts shall be coated with a rust-inhibiting primer and a gray baked enamel finish. Hardware shall be plated to prevent corrosion. Wireway shall be of standard dimensions and sized in accordance with the National Electrical Code for the particular installation. Wireway shall be Square D "SQUARE-DUCT" or approved equivalent.

2.2 OUTLET BOXES

- A. Provide outlet boxes, pull boxes, and conduit fittings as described below. Catalog numbers shown are those of Appleton Electric Company. Steel City, National Electric Products Corp., and Racor are equally acceptable. Comply with NEMA OS-1 and FB.
 - 1. Lighting Boxes (concealed) - No. 40-3/4.
 - 2. Lighting Boxes (concrete) - No. OCR Series.
 - 3. Lighting Boxes (exposed) - No. 4S-3/4 or 40-3/4.
 - 4. Switch, Receptacle, Telephone and Junction Boxes (flush) - No. 4S-3/4 or No. 225 where separate extension or plaster ring cannot be used.
 - 5. Switch, Receptacle, Telephone and Junction Boxes (exposed) - FS Series.
 - 6. Switch and Telephone Boxes (concealed in narrow mullions) - Bell Electric Co. No. 447, 448, or 449.
 - 7. Weatherproof or Exterior Boxes - FS Series with weatherproof while-in-use cast metal cover and neoprene gasket.
- B. Where space is limited, No. 4CS-3/4 handy boxes may be used for a switch, receptacle, telephone or other outlet.
- C. Provide extension and plaster rings as required.
- D. Size outlet boxes in accordance with the allowable fill permitted by the National Electrical Code.

2.3 PULLBOXES

- A. Provide code gauge galvanized sheet metal pull boxes sized as per the National Electrical Code or as shown on the drawings. Provide a removable cover on the largest access side of the box unless otherwise detailed. Where cast boxes are specified, provide conduit entrances with

threaded hubs. Provide stainless steel screws in all exterior locations and in wet or damp locations.

2.4 CONDUIT FITTINGS

- A. UL-514B, NEMA FB-1 and NEMA TC-3 listed. Steel material, die-cast is not acceptable.
- B. EMT Couplings:
 - 1. Series 95T gland compression (all locations).
 - 2. Series TWC set screw (indoor only but not encased in concrete or masonry).
 - 3. Steel material, die-cast is not acceptable.
- C. EMT Connectors:
 - 1. Series 86T gland compression (all locations)
 - 2. Series TW set screw (indoor only - but not encased in concrete or masonry).
 - 3. Steel material, die-cast is not acceptable.
- D. Insulating Bushings (1-1/4 inch rigid conduit and larger) - Series BBU.
- E. Straight Box Connectors (flexible conduit) - Series 728 9V.
- F. Angle Box Connectors (flexible conduit) - Series 738 2V.
- G. Sealing Gland Assembly - OZ, Type FSK.
- H. Expansion Joints - OZ, Type AX or TX with bonding jumpers and clamps.
- I. Expansion and Deflection Fittings - OZ, Type DX.
- J. Cast Metal Conduit Fittings - Crouse-Hinds, Condulets form 7 with wedge nut cover.

2.5 PREFABRICATED CONDUIT STANDS ON ROOF

- A. Shop fabricated assemblies made of corrosion-resistant components to support roof mounted conduit and compatible with roof surfaces.
- B. Caddy Pyramid fixed and adjustable strut supports of length, load rating and height to match requirements.

PART 3 - EXECUTION

3.1 RACEWAYS - GENERAL

- A. Install all wiring, including telephone, low voltage, etc., in raceways as indicated on the plans and in this specification.
- B. Install raceways concealed, except in mechanical equipment rooms or where indicated on the plans.
- C. Minimum raceway size shall be 1/2" for interior applications and 1" for exterior applications.

3.2 APPLICATION

- A. Conduits located exposed, concealed inside shafts or column enclosure and all homeruns shall be EMT. PVC shall be used in concrete slabs, but last elbow out of floor slab shall be IMC. Minimum 2" concrete above conduit.
- B. Conduits run horizontally between boxes containing wiring devices in walls shall be either EMT or metallic flexible conduit. The maximum length of metallic flexible conduit between wiring devices in furred walls shall be twelve (12) feet. All other horizontal conduit in furred walls shall be EMT.
- C. Exterior conduits exposed above grade shall be galvanized rigid steel, 1" minimum.
- D. Sleeves and conduits for feeders over 600 volts shall be rigid steel conduit.
- E. Conduits for connection to vibrating equipment such as motors, transformers, etc., and for heat loops to light fixtures from junction boxes above them shall be metallic flexible conduit, maximum length of six feet. Weatherproof Sealtite shall be used in damp or wet locations.
- F. Conduits located below grade in direct contact with the earth shall be schedule 40 PVC conduit. These raceways shall be encased in 3 inches of concrete where indicated. Refer also to 260115, Underground Ducts.
- G. Provide cable tray, wiremold, plugmold, wireways, and other special raceways where indicated on the drawings. Wiremold shall be used for all circuits which will be exposed in finished spaces.
- H. Any type of conduit or raceway that is specifically labeled on the plans shall take precedence over the specification. Obtain written permission from the Engineer for any other deviation from the specification requirements.
- I. Keep emergency and normal raceways separate and follow separate routes. Normal and emergency conductors shall not be installed in the same raceway.

3.3 INSTALLATION

- A. Continuity. Provide metallic raceways continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes. Enter and secure conduit to all boxes to provide electrical continuity from the point of service to outlets. Provide double locknut and bushing on terminations of metallic conduits.
- B. Raceways Exposed. Run exposed raceways in straight lines at right angles or parallel with walls, beams or columns. Paint to match surrounding finish unless required otherwise.
- C. Raceways in Concrete:
 - 1. Do not place raceways in plain concrete, such as cement toppings on structural floors, without special approval of the Architect.
 - 2. Do not displace reinforcing steel to accommodate the installation. In general, locate all embedded conduits in the physical center of the particular section of concrete. Provide

raceways embedded in reinforced concrete conforming to the following usual types of conditions.

3. Floors and Walls - Maximum Allowance: Displacement of 1/3 of thickness of concrete spaced not less than three diameters on centers.
 4. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- D. Sleeves: Sleeves through floors and walls shall be not less than three diameters on centers. Conduit sleeves in floors shall be steel and shall extend 3 inches above the finished floor and flush with the underside of the floor slab. Size sleeves to provide ¼" annular clear space (interior sleeves) or 1" (exterior sleeves) between sleeve and raceway.
- E. Sealing of Sleeves: Openings and sleeves through which a conduit passes in non-fire rated walls, floors, and ceilings shall be properly sealed after the conduit is installed to prevent transmission or leakage of liquids, smoke, and sound. Conduit passing through drywall construction or sleeves shall be sealed both sides of the opening shall be caulked with a resilient non-hardening caulking such as U.S.G. Acoustical Sealant, Tremco, or approved equal.
- F. Sealing of Sleeves: Conduit passing through fire rated floors, walls and ceilings shall be sealed by a UL Listed System with hourly rating equivalent to fire rated floors, walls or ceilings. Fire proofing materials by S.T.I., U.S.G., Tremco, 3M and Hilti must be installed according to UL Listed Systems.
- G. Sleeves for fire rated walls and ceilings where data, voice, etc., cables penetrate fire walls or fire rated ceilings provide a fire stopping system as manufactured by STI EZ-Path, Wiremold FlameStopper or equal. Fire stopping system shall be UL classified and FM approved in accordance with ASTM E814 (UL1479).
- H. Raceways Through Exposed Roof: Where raceways penetrate the roof seal, provide suitable pitch pockets of lead flashing or flexible boot-type flashing units applied in coordination with roofing work.
- I. Raceways Entering the Building Below Grade (or raceways through a roof covered by earth): Provide raceways with stainless steel plates and hardware with EDPM or NBR links and wall entrance mechanical sleeve seals having a water tight sealing gland assembly where the raceways enter into a dry area. Use OZ/Gedney type FSK or equivalent seal. Following installation of conductors, cables and pull tapes in raceways, provide water stop inside conduits equivalent to Tyco RDSS and RDSS-Clip inflatable sealing bladders.
- J. Bends: Where more than one conduit in a bank of exposed conduit changes direction, all bends shall be concentric. Conduit bends shall not be less than standard radius. Conduit bends for power feeders over 600 volts and for telephone feeders shall be long radius.
- K. Threads: Clean all threads of rigid conduit. Coat all male threads of all steel conduit installed underground or in or under concrete slabs with teflon immediately before being coupled together.
- L. Running Threads: Use "Erickson" type couplings in lieu of running threads.
- M. Protection: Cap raceways stubbed up, including those in cabinets, immediately upon their installation. The use of paper or rag wads will not be permitted.

- N. Expansion Joints. Provide raceways crossing expansion joints with Type BJ bonding jumper for bonding conduit or tubing together. Where differential settlement may occur, use deflection fittings.
- O. General Location Requirements. Raceway runs shown are diagrammatic. Determine exact locations in the field except where otherwise noted or where dimensions are specified on the drawings. Conduits shall not run within 12 inches of pipes carrying hot liquids, steam, or gases.
- P. Pull Tapes. Empty conduits shall be provided with a pull tape.
- Q. Provide accessories as required for a complete installation, including insulated bushings and inserts where required by the manufacturer or NEC. Provide insulated bushings on all conduit stub-ups, where conduit does not terminate in a box or enclosure, and on all enclosure openings where cables enter or exit unprotected by conduit.
- R. Install no more than the equivalent of three 90-degree bends in any conduit run except for communication conduits. Communications conduits shall have a maximum of two 90-degree equivalent bends for each raceway. Communication conduits 3/4" and less shall be installed in maximum lengths of 50 feet and 1" and larger at 75 feet maximum lengths.

3.4 RACEWAYS SUPPORTS

- A. Supports. Install raceway supports in accordance with the requirements of the National Electrical Code. Do not anchor or strap conduits to the ceiling furring channels or attach to ceiling hanger wires.
- B. Straps and Hangers. Conduit shall be supported from building structure on approved types of galvanized brackets, ceiling trapeze or pipe straps, or hangers secured by means of toggle bolts on hollow masonry; or expansion bolts in concrete or brick; or machine screws on metal surfaces; or wood screws on wood construction. Conduits shall be attached to the hanging systems by fittings equal to those manufactured by Caddy Fasteners. Nails shall not be used as a means of fastening boxes or conduits. Perforated flat steel straps shall not be used for supporting conduit. Conduits shall not be supported from ductwork or ductwork supports. Conduit shall be properly supported in order to deter any possible vibration, noise, or chatter.

3.5 PREFABRICATED CONDUIT STANDS

- A. Conduit Stands: In general, provide a low type support. Where the elevation of the roof changes or where the conduit is required to slope, provide an adjustable type support that can accommodate the different support heights needed to maintain the proper conduit elevation above the roof.
- B. Conduit support schedule:

Conduit Type	Erico Caddy Basis of Design		Support Spacing
	Model	Max Height	
EMT/IMC/RIGID	F: PSF6C	F: 4.8 inches	60 inches
EMT/IMC/RIGID	A: PSA10CH13	A: 13 inches	96 inches

EMT/IMC/RIGID	A: PSA16AH18	A: 18 inches	96 inches
Notes: 1. Conduit support spacings are maximums. Adjust so maximum base load does not exceed 2.5 psi, or deflection of conduit or piping exceeds 1/240 of span between supports. 2. Locate supports within 12 inches of each conduit joint. 3. Locate supports within 24 inches of each change in direction of conduit. 4. Use adjustable-type units where fall of roof differs from required fall of item supported. 5. Do not use wood blocking to produce fall in supported items. Do not shim or install wedges under conduit supports. 6. For use and conditions other than those listed, select from conduit supports specified, or if not otherwise indicated for application, from manufacturer's product selections suited and applicable for use and conditions. 7. F: Fixed-Height Units; A: Adjustable Height Units. 8. Provide conduit strap(s) to hold conduit(s) to unit.			

- C. Preparation: Clean roof primary or secondary membrane surfaces at each conduit support base. Remove loose dirt, dust, oils, and other foreign materials from all roofs.

1. For membrane roofing systems, refer to Division 07 Sections for requirements for preparations for setting of conduit support bases.

- D. Installation: Support all electrical, control, data, or other conduits, and other horizontal conduits for their entire length.

1. Assemble frames, bases, hangers, clamps, rollers, clevises, and hardware per manufacturer's instructions using corrosion-resistant or stainless steel fasteners and clamps.
2. Anchor or clamp conduits to conduit supports unless otherwise indicated.
3. Adjust supports to place supported items at proper elevation, true to line, without abrupt changes of plane or direction, with conduits fully seated on supports strapping.
4. Install conduit supports to allow for anticipated expansion and contraction of conduits without movement of bases.
5. Install roller type supports at each side of roof expansion assemblies.
6. Do not exceed maximum loads on each support per conduit support manufacturer.
7. Space conduit supports closer together where required to comply with maximum weight limitations on each support assembly.

- E. Setting: Set conduit support bases in accordance with roofing and conduit support manufacturer's installation instructions. Accurately locate and align bases.

1. Install conduit supports with base assemblies centered in secondary roofing membrane applied atop primary roof membrane surfaces.
2. Coordinate installation of membrane straps with base conditions and configuration.
3. Refer to Division 07 Sections for roofing requirements for conduit support bases.

3.6 JOINTS AND CONNECTIONS

- A. Metal Conduits: Make watertight all couplings and threaded connections in threaded conduit. Cut all joints square, ream smooth, and properly thread. Fit all box connections with a minimum of two approved locknuts and one steel, plastic or fiber bushing forming an approved tight bond with box. Provide locknuts both inside and outside of the enclosure to which the conduit is attached. Use rain tight compression type fittings for electrical metallic tubing systems and use at least one locknut on the inside of each enclosure entry. Provide grounding locknuts or bushings where required in Section 260455 GROUNDING SYSTEMS.
- B. PVC Conduits: Make watertight all couplings and connectors in conduit runs. Utilize solvent cement joints of a type approved by the manufacturer for all couplings and fittings. Provide adapters and locknuts where conduit is attached to metal junction boxes, panels, etc.
- C. Join raceways with fittings designed and approved for the purpose and make joints tight. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight. Use insulating bushings to protect conductors.
- D. Tighten set screws of threadless fittings with suitable tool.
- E. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box.
- F. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- G. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixture; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor in flexible connections.

3.7 BOX APPLICATIONS

- A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
 - 1. Interior Dry Locations: Sheet steel, NEMA type 1.
 - 2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
 - 3. Wet Locations: NEMA type 4X enclosures.
- B. Through-wall boxes are not permitted. Offset back-to-back boxes in the same wall not less than 3". If boxes are in fire rated partitions, offset boxes a minimum of 24" or provide fire rated "putty pads" on boxes. If boxes are in the same stud cavity and open to opposite sides of the wall, provide "putty pads" on boxes.
- C. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location, except as otherwise indicated.

3.8 OUTLET BOX INSTALLATION

- A. Install items where indicated and where required to suit code requirements and installation conditions.
- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
- C. Support and fasten items securely in accordance with Division 26 Section "Supporting Devices."
- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- E. Remove sharp edges where they may come in contact with wiring or personnel.
- F. Mounting: Mount outlet boxes for switches with the long axis vertical. Mount boxes for receptacles vertically. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not cover different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges.
- G. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2 inches deep, minimum.
- H. Protect outlet boxes to prevent entrance of plaster and debris. Thoroughly clean foreign material from boxes before conductors are installed.

END OF SECTION 260110

SECTION 260111 – WIRE BASKET CABLE TRAY**PART 1 - GENERAL****1.1 SECTION INCLUDED**

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire basket cable tray as shown on the drawings.
- B. Wire basket support systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.
- C. Cable tray shall support voice, data, access control, security, video surveillance, public address and similar low voltage cables.

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code, Article 392 - Cable Trays
- B. ASTM A510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- C. NEMA VE 1-2009 - Metal Cable Tray Systems
- D. NEMA VE 2-2013 - Cable Tray Installation Guidelines
- E. NECA / NEMA 105 - "Standard for Installing Metal Cable Tray Systems"

1.3 DRAWINGS

- A. The drawings, which constitute a part of these specifications, indicate the general route of the wire basket support systems. Field verification of all dimensions, routing, etc., is required.
- B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.4 SUBMITTALS

- A. Submittal Drawings: Submit drawings of wire basket and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold down plates showing accurately scaled components.
- B. Product Data: Submit manufacturer's data on wire basket support system including, but not limited to, types, materials, finishes and inside depths.

1.5 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 392, NEC).
- B. NFPA Compliance Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver wire basket support systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.
- B. Store wire basket and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

PART 2 - PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturer: Subject to compliance with these specifications, wire basket support systems to be installed shall be as manufactured by Cablofil, Cooper B-Line, Inc., or engineer-approved equal.

2.2 WIRE BASKET SECTIONS AND COMPONENTS

- A. General: Provide wire basket of types and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.
- B. Materials and Finishes: Material and finish specifications for each wire basket type are as follows:
 - 1. Electroplated Zinc: Straight sections shall be made from steel and shall be electro-plated zinc. All threaded components and support accessories shall be coated with zinc.
 - 2. Stainless Steel: Straight sections and accessories shall be made from AISI Type 304L Stainless Steel.
 - 3. Paint: Straight sections shall be painted Flat Black over Electrodeposited Zinc.
 - 4. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.

2.3 TYPE OF WIRE BASKET SUPPORT SYSTEM

- A. Wire basket shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All wire ends along wire basket sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
- B. Wire basket sizes shall conform to the following nominal criteria:
 - 1. Straight sections shall be furnished in standard 118 inch lengths.
 - 2. Wire basket shall have a 1 inch usable loading depth by 6 inches wide.
 - 3. Wire basket shall have a 2 inch usable loading depth by 8 inches wide.
 - 4. Wire basket shall have a 4 inch usable loading depth by 12 inches wide.
- C. All fittings shall be field formed as needed.

- D. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either electrozinc plated, hot dipped galvanized or AISI Type 304L / 316L Stainless Steel.
- E. Wire basket supports shall be trapeze hangers or wall brackets as manufactured by Cooper B-Line, Inc., Cablofil, or engineer approved equal.
- F. Trapeze hangers shall be supported by 1/4 inch or 3/8 inch diameter rods.
- G. Special accessories shall be furnished as required to protect, support and install a wire basket support system.
- H. Underfloor mounting shall be with support clamps to pedestals or support stands to floor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wire basket as indicated; in accordance with NEMA VE-2 and recognized industry practices, to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
- B. Coordinate wire basket with other electrical work as necessary to properly interface installation of wire basket runway with other work.
- C. Provide sufficient space encompassing wire basket to permit access for installing and maintaining cables. In no case shall there be less than 6" of clear space above the top of the tray.
- D. Seal penetrations through fire and/or smoke barriers according to Division 07 Section "Penetration Firestopping" with Wiremold FlameStopper 4", Hilti CP 653-4" or STI EZPath Series 44+. Install E90 certified cable tray (90 minute fire rated) for fire alarm cables, critical circuits, corridors or at paths of egress, as indicated on drawings.

3.2 TESTING

- A. Test wire basket support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.
- B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1.

END OF SECTION 260111

SECTION 260120 - CONDUCTORS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes conductors, wires, cables and associated splices, connections and terminations for wiring systems rated 600V or less.

1.3 QUALITY ASSURANCE

- A. Conductors and cable shall conform to UL, NEMA WC70, NECA 120, NFPA 70 and ICEA S-95-658 requirements.
- B. Comply with NECA 120, "Standard for Installing Armored Cable (Type AC) and Metal Clad Cable (Type MC)."
- C. Comply with NECA / AA 104, "Standard for Installing Aluminum Building Wire and Cable."

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Wires and Cables
 - 1. AFC Cable Systems, Inc.
 - 2. BICC Brand-Rex Company
 - 3. Cerrowire
 - 4. Colonial Wire and Cable Co., Inc.
 - 5. Encore Wire
 - 6. General Cable Corporation
 - 7. Okonite Company
 - 8. Prysmian Group
 - 9. Service Wire Company
 - 10. Southwire Company
- B. Connectors for Wires and Cables
 - 1. AMP Inc.
 - 2. General Signal; O-Z/Gedney Unit
 - 3. Tyco Electronics Corporation
 - 4. Square D Co.; Anderson
 - 5. 3M Company; Electrical Products Division
 - 6. AFC Cable Systems, Inc.
 - 7. Erico, Inc.
 - 8. Hubbell Power Systems, Inc.

9. ILSCO Corporation
10. Thomas & Betts Corporation

2.2 CONDUCTORS

- A. Provide copper conductors with insulation rated for 600 volts, dual rated type THHN/THWN-2 for interior use and type XHHW-2 for exterior installation.
- B. Conductors No. 10 AWG and smaller shall be solid. Conductors No. 8 AWG and larger shall be stranded.
- C. Provide single copper conductors throughout. Provide No. 12 AWG minimum branch circuit wire size. Provide No. 14 AWG for control circuits, unless otherwise specified or required by overcurrent protection.
- D. For exterior feeders or branch circuits, provide Type XHHW-2 conductors installed in underground raceways.

2.3 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for application and for service indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.4 CABLES

- A. Type MC cable shall be THHN/THWN-2 insulated circuit conductors with full size insulated ground wire enclosed within flexible metal covering. Metal covering shall be galvanized steel.
- B. Type AC cable shall have THHN/THWN-2 insulated circuit conductors with bonding conductor enclosed with flexible metal covering. Metal covering shall be galvanized steel.
- C. Connectors and fittings for type MC and type AC cable shall be manufactured and listed for that purpose.

2.5 TYPE NOT PERMITTED

- A. The following wire and cable types are not permitted to be used:
 1. BX
 2. NM/NME
 3. TW

PART 3 - EXECUTION**3.1 CONDUCTOR SIZES AND TYPES**

- A. Low voltage wire and cable for audio, signal and control cables are specified elsewhere in this Specification.

- B. Any 120V lighting and receptacle circuit, whose home run length from panel to first fixture or device exceeds one hundred (100) feet for 120V circuits, shall not be less than 10 gauge for the entire length of run, to minimize voltage drop.
- C. Wire size and insulation type entering any lighting fixture or equipment shall be as recommended by the manufacturer and as minimally required by the codes. Where no recommendation is given by the manufacturer, the wire size and insulation type shall meet the minimum rating of the wiring or terminations used in the fixture or equipment.
- D. Conductor sizes for motors, equipment and feeders shall be as indicated. See Schedules on drawings.
- E. Type AC cable may be used only for flexible connections to recessed lighting fixtures from separately mounted outlet boxes. Length shall not exceed six feet.
- F. Type MC cable may be used only for flexible wiring from outlet boxes mounted above accessible ceilings to wall switches and wall mounted 120V duplex receptacles. Junction box where flexible cable starts shall be part of branch circuit conduit system located in accessible ceiling space. MC cable shall not be used for homeruns. Use EMT conduit for all homeruns and connection to Electrical Panels.

3.2 INSTALLATION

- A. Wire and cable shall be installed in conduit, duct, wireway, surface raceway or other raceway specified. No conductors or cables shall be installed in conduits, ducts or raceways until the raceway system has been completed and free of any dirt or water. When installing conductors, exercise due care to prevent damage to conductors and insulation.
- B. Wire 10 gauge or smaller shall be spliced, tapped or joined in outlet or junction boxes with solderless spring-type connectors. Bakelite insulated wire nuts are not approved.
- C. Conductors 8 gauge and larger shall be terminated using bolted pressure or compression type connectors. They shall be specifically designed for use with the type conductors being installed in compliance with manufacturer's recommendations.
- D. Uninsulated splices, joints and free ends of conductors shall be covered with rubber and friction tape or high dielectric polyvinylchloride Scotch No. 33 Plus electrical tape.
- E. Feeder cables shall be continuous from origin to panel or equipment termination without splices in intermediate pull or splice boxes or raceway runs. Where taps and splices are necessary, they shall be made in approved splice boxes with suitable compression type connectors.
- F. Fixture and branch circuit wiring joints in exterior junction and outlet boxes shall be made with waterproof connectors rated at 600 volts maximum (1,000 volts when enclosed in fixture or sign).
- G. Exterior branch circuit conductor splices below grade shall occur only in gasketed weatherproof junction boxes. Use split bolt connector with Okonite self-fusing tape #35, wrapped by Scotch #33 Plus tape and sealed with 3M High Gel Re-enterable Encapsulant #8882.

- H. Coordinate wire installation with other work. Support cables in accordance with Section 260190.
- I. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary. Perform pull tension calculations and do not exceed those values.
- J. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cable or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- K. Keep conductor splices to a minimum. Provide splice and tap connectors which possess better mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors which are compatible with conductor materials.
- L. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Make terminations so there is no bare conductor at the terminal. Bundle conductor sizes #12 and #10 together. Bundle individual circuits larger than #10 separately.
- M. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.
- N. Connect wiring devices, light fixtures, panelboard devices and other electrical equipment to the wiring systems as indicated and in accordance with manufacturer's instructions.
- O. Leave a minimum of 12" pigtail at each outlet for termination purposes.
- P. Home runs shall be in conduit. Not more than three (3) branch circuits may be grouped in one (1) homerun to a branch circuit panelboard. Derate conductors per NEC requirements and count the neutral as a current carrying conductor.
- Q. Through-wiring is not permitted for recessed lighting fixtures. Each recessed lighting fixture shall be connected by flexible metal-clad cable to a separate junction box mounted above ceiling, which may serve no more than four fixtures. This flexible cable shall be Type MC or AC cable, with ground.
- R. Through-wiring is permitted for continuous rows of surface-mounted or pendant-mounted light fixtures. Fixture rows, pendant or surface-mounted, shall be fed through a flush ceiling-mounted outlet box. Branch circuit conductors for through-wiring shall have a minimum temperature rating of 90°C, or higher, if required by lighting fixture manufacturer.
- S. Install conductors with compression type motor pigtail connectors of sizes as required for motors and mechanical equipment. Connectors shall be rated for 600V, 90 degrees C, and tin plated copper with the thermoplastic elastomer insulator.
- T. Where lugs or termination points are not sized to accommodate the wire size specified or are not listed for the conductor material, provide pin connectors rated for use with

copper/aluminum conductors and terminate with a tool and die size recommended by the connector manufacturer.

- U. Keep emergency conductors independent and separate from all other conductors. Do not route emergency conductors and normal conductors in the same raceway.

3.3 FIELD QUALITY CONTROL

- A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Visually inspect all terminations are tight and proper and materials installed are in accordance with the specification section.
- B. Prior to energizing test wires and cables for electrical continuity and for short-circuits and proper phase relationship. Verify conductors are appropriately color coded.
- C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- D. Torque all connections/lugs in accordance with manufacturer instructions. Where torque valves are absent, follow ANSI/NETA Standard for acceptance testing specifications.

3.4 COLOR CODING FOR PHASE IDENTIFICATION

- A. Color code secondary service, feeder and branch circuit conductors with factory applied color as follows:

<u>208Y/120 Volts</u>	<u>Phase</u>	<u>480Y/277 Volts</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- B. Where the local jurisdiction requires otherwise, match local requirements including but not limited to jurisdictions that prohibit the use of orange except for high leg center tapped delta systems, in which case the B phase conductor shall be purple.
- C. Phase conductors with special marking, such as in type MC cable assemblies, shall be acceptable.
- D. Conductors manufactured in only one color shall be marked with colored tape at each termination to identify each conductor as phase, neutral or ground.
- E. Ungrounded conductors supplied from more than one nominal voltage system shall be separately identified where accessible.

END OF SECTION 260120

SECTION 260140 – WIRING DEVICES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section covers wiring devices, including floor boxes and outlets, and multi-outlet surface metal raceways.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 RELATED SECTIONS

- A. Provide boxes and raceways as specified in Section 260110 - RACEWAYS, FITTINGS AND BOXES.

1.4 QUALITY ASSURANCE

- A. Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Comply with NECA 130, "Standard for Installing and Maintaining Wiring Devices."

PART 2 - PRODUCTS**2.1 SWITCHES**

- A. Switches shall be specification grade, quiet operating type rated 120/277V, 20 amperes, color as selected by architect, types as listed below:

	<u>HUBBELL</u>	<u>EATON</u>	<u>P&S</u>	<u>LEVITON</u>
Single Pole	CSB120-*	2221	PS20AC1-*	1221-2*
Double Pole	CSB220-*	2222	PS20AC2-*	1222-2*
Three Way	CSB320-*	2223	PS20AC3-*	1223-2*
Four Way	CSB420-*	2224	PS20AC4-*	1224-2*
Key-Single Pole	HBL1221L	2221L	PS20AC1*L	1221-2L
Pilot Light (1P)	HBL1221PLC	2221-PL	PS20AC1CPL	1221-PL

- B. Switches shall comply with UL Standard 20, and with Federal Specification W-S.
- C. Manufactured modular connector devices equivalent to Pass Seymour Plug Tail shall be acceptable.
- D. Switches on UPS circuit shall be red in color.

2.2 WALL DIMMERS

- A. Dimmers shall be specification grade UL Listed (File #E-47967), designed for the demands of a commercial application.

Sensor Switch	WSX-PDT-D-*	800W	Occupancy sensor with dimmer
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EATON SKYE SF10P-W 1200W LED

2.3 RECEPTACLES

- A. Receptacles shall be NEMA 5-20R, grounding type, rated 20 amperes, 125 volt, color as selected by architect (provide gray for WP cover plates), types as listed below:

	<u>HUBBELL</u>	<u>EATON</u>	<u>P&S</u>	<u>LEVITON</u>
Duplex	HBL5362-*	5362*	5362-A*	5362-*
Single	HBL5361-*	5361*	5361-*	5361-*
Ground Fault	GFST20*	VG F20*	2096*	S7899-*
Ground Fault Tamper Resistant	GFR5362SG*	---	2096TR*	GFTR2-*
(Ground fault receptacle shall be of self-test diagnostic with red and green indicator lights.)				
Ground Fault Weather Resistant	GFR5362SG*	---	2095TRWR*	GFWT2-*
Duplex Tamper Resistant	HBL8300SG*-A	---	TR5362*	SG63H-*
Duplex Isolated Ground	IG5362*	IG5362RN	IG5362*	IG5362
Duplex – Half Controlled	BR20C1*	5362CH*	5362CH*	5362S1*
Duplex – Half Ctrlld TR	HBL5362C1*TR	TR5362CH*	TR5362CH*	53621P*
Surge Protection Duplex	HBL5362*SA	TR5362*S	5362-*SP	5380-*

- B. Manufactured modular connector devices equivalent to Pass Seymour Plug Tail shall be acceptable.
- C. Receptacles with USB charger shall be rated 20A circuit feed through, 125V, color as selected by architect (provide decorator type cover plate.) USB charger rated 5A, 5VDC Type A and 55 Watt, 20VDC Type C.

Duplex with USB Charger: HUBBELL Cat #: USB20ACPD*.

- D. Dryer receptacle shall be NEMA 14 30R grounding type, rated 30 amperes, 3 pole, 4 wire, 125/250 volt black color, types as listed below:

	<u>HUBBELL</u>	<u>EATON</u>	<u>P&S</u>	<u>LEVITON</u>
Dryer Outlet	RR430F	1257	3864	278

- E. Range receptacle shall be NEMA 14-50R grounding type, rated 50 amperes, 3 pole, 4 wire, 125/250 volt black color types as listed below:

	<u>HUBBELL</u>	<u>EATON</u>	<u>P&S</u>	<u>LEVITON</u>
Range Outlet	RR450F	1258	3894	279

- F. Receptacles shall comply with UL Standard 498 Federal Specification WC596F.

2.4 RECEPTACLES ON UPS CIRCUITS

- A. Receptacles shall be NEMA 5-20R, grounding type, rated 20 amperes, 125 volt, red color, types as listed below:

	<u>HUBBELL</u>	<u>EATON</u>	<u>P&S</u>	<u>LEVITON</u>
Duplex	HBL5362-R	5362-RD	5362ARED	5362-R
Single	HBL5361-R	---	5361RED	5361-R
Ground Fault	GF202RLA	---	2095RED	EQUIVALENT
Duplex Tamper Resistant	BR20ITR	---	TR5362RED	6898HG-R

- B. Manufactured modular connector devices equivalent to Pass Seymour Plug Tail shall be acceptable.

2.5 COVERPLATES

- A. Provide coverplates of the appropriate type and size on all devices.
- B. Coverplates shall be the same color as the device, smooth thermoplastic nylon, as manufactured by Cooper, P&S, Hubbell or Leviton.
- C. Receptacles and coverplates for UPS outlets shall be red.
- D. Switches and coverplates for UPS circuits shall be red.
- E. Devices recessed in or surface mounted on CMU/masonry wall shall have stainless steel coversplates.
- F. Device plates that will contain pilot lights shall be metal, smooth, jumbo type.
- G. Where devices are installed in exposed fittings or boxes, use Appleton "FSK" covers.
- H. Install blank covers on boxes without devices.
- I. Weatherproof Cover Plates (WP Designation)
1. Receptacles in Damp Locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).
 2. Receptacles in Wet Locations shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as "extra-duty".
 3. Vertical mounting: Cast aluminum mounted on FS/FD box, suitable for GFI receptacle: TayMac MX3200, Hubbell HBL WP26M, P & S WIUC10CABRV, Cooper WIUMV-1, Leviton IUM1V-GY.
 4. Horizontal Mounting: Cast aluminum, mounted on FS/FD box, suitable for GFI receptacle: TayMac MX3300, Hubbell WP26M, P & S WIUC10CABRH, Cooper WIUMH-1W, Leviton IUM1H-GY.

2.6 SPECIAL USE OUTLETS

- A. Floor outlets: Refer to electrical plans and details.
- B. Provide special purpose outlets as indicated on the drawings.

2.7 MULTI-OUTLETS SURFACE RACEWAY

- A. Multi-outlet surface metal raceway shall be Wiremold or Hubbell 3000 as indicated on the drawings. Receptacles and device plates shall be as specified above. Finish shall be manufacturer's standard. Length shall be as indicated on the drawings.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical and grounding terminal of receptacles on top. Group adjacent devices under single, multi-gang wall plates.
- D. Protect devices and assemblies during painting.
- E. Adjust location where floor service outlets and telephone/power service poles are installed to suit the indicated arrangement of partitions and furnishings.
- F. Receptacles shall be repositioned not more than 10 feet from location indicated, when so directed by the Architect, at no cost to the owner.
- G. Barriers: Provide compartment and/or outlet box barriers between device for the following conditions:
 - 1. Where devices, receptacles or switches are served by normal and emergency power sources.
 - 2. Where devices operate at different voltage.
 - 3. Multiple wall switches operating at 120V and 277V and multiple 277V switches.
- H. Install exterior GFI receptacles horizontally, with weatherproof cover plate.

3.2 MOUNTING HEIGHTS TO CENTERLINE OF DEVICE

- A. Receptacles: 18" above floor.
- B. Wall switches: 46" above floor.
- C. Counter Receptacles: 6" above back splash.

3.3 GROUNDING

- A. Receptacle ground terminal: Connect ground terminal to grounding conductor routed with circuit conductors.

3.4 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity.
- B. Test ground-fault circuit interrupter operation according to manufacturer recommendations.

- C. Replace damaged or defective components.

3.5 CLEANING

- A. General: Internally clean devices, device outlet boxes and enclosures. Replace stained damaged or improperly painted wall plates or devices. Devices with drywall mud, spackle, and caulk, adhesive or other foreign material shall be considered damaged and replaced.

END OF SECTION 260140

SECTION 260150 - MOTORS AND MOTOR CONTROLS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. This section covers motors and motor control devices.
- C. Comply with NECA 230, "Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers."

PART 2 - PRODUCTS**2.1 GENERAL**

- A. Unless otherwise indicated, all motors 3/4 horsepower and larger shall be connected for operation at 208 volts or 480 volts, 3 phase, and motors less than 3/4 horsepower shall be connected for operation at 115 volts, single phase.
- B. Motors. All motors shown on the drawings will be furnished and set in place under the respective section where the equipment is specified.
- C. Control devices such as aquastats, firestats, freezestats, etc., are furnished under the Mechanical Contract, and wiring from each such device to the motor starter is included in the Electrical Contract, unless specifically indicated otherwise.
- D. Control devices such as electro-pneumatic switches, thermostats, flow switches, etc., are furnished under the Mechanical Contract, and wiring from each such device to the motor starter is included in the Mechanical Contract, unless specifically indicated otherwise.
- E. Motor Controls. Unless specifically indicated otherwise, provide all power wiring, disconnects, starters, relays, pushbuttons, pilot lights, motor connections, supports, and all appurtenances required for the safe and satisfactory control of all motors.
- F. Refer to the Equipment Schedules on the drawings and Division 21, 22, & 23 sections.

2.2 MOTOR STARTERS

- A. Provide magnetic starters for three-phase motors. Provide manual starters for single-phase motors unless otherwise indicated. NEMA 1 enclosure is standard, but for enclosures exposed to the weather provide NEMA 3R enclosures. Square D starters are specified to establish quality and general requirements. Comparable starters manufactured by Siemens, Eaton or ABB will be acceptable.
- B. In each magnetic starter provide:
 - 1. Cover-mounted "Start" button, cover-mounted "Hand-Off-Automatic" selector switch or "Start-Stop" pushbutton as shown on Motor Control Schedule, and manual overload reset button.

2. Red "On" pilot light.
 3. One solid state overload relay with adjustable trip setting properly sized for the actual motor nameplate current and motor operating conditions. Multiply by 1.15 for 1.15 service factor motor. Solid state relay shall have phase loss, phase unbalance protection and shall be ambient temperature insensitive. Use heater type overload relays only in open delta or ground "B" phase systems.
 4. Minimum of two auxiliary contacts plus those scheduled (maximum 4).
 5. Control transformer (unless otherwise indicated) for maximum control voltage of 120 VAC complete with primary and secondary overcurrent and short circuit protection.
- C. Manual Motor Starters: Provide Square D, Class 2510, 2511, 2512, single pole, complete with red "On" pilot light, toggle switch, overload relay, and manual overload reset. Provide flush mounting with stainless steel plate in finished areas and surface mounting in unfinished areas. The starter shall have a minimum rating of 1 horsepower at 240 VAC.
- D. Full Voltage Magnetic Starter: Provide Square D, Class 8538, non-reversing, sized for the horsepower and current rating of the motor. The minimum size shall be NEMA size 0.
- E. Combination Starters:
1. For indoor application, provide Square D, Class 8538 with fused or non-fused disconnect as indicated.
 2. For outdoor application, provide Square D, Class 8538(NEMA 3R) with fused or non-fused disconnect as indicated.
- F. Remote controls: Provide Square D, Class 9001, 22mm pushbuttons and selector switches, oil tight type, with red "ON" pilot light. Provide flush mounting with stainless steel plate in finished areas and surface mounting in unfinished areas. Provide momentary "Start-Stop" buttons or maintained contact three-position "Hand-Off-Automatic" selector switch, as indicated.
- G. Provide time delay relays in starters for motors 10hp or more. Set delay time for motors to start at staged times upon loss of normal power

PART 3 - EXECUTION

- 3.1 Coordinate all details pertaining to the motor control equipment with the mechanical and temperature control installation. This includes, but is not limited to: motor size, coordination of motor starter coil voltage ratings, verification and coordination of mechanical control device voltage and amp ratings, and coordination of pilot control devices such as momentary contact versus maintained contact.
- 3.2 All Temperature Control Wiring (below 100 VAC) will be provided by the Mechanical Contractor. All interlock wiring (100 VAC and above) shall be provided by the Electrical Contractor, unless otherwise indicated. See the Motor Schedule on the plans and Sequence of Controls Specification section 230965 for detailed requirements. In general, the interlock wiring is not shown on the plans, but is called out in the Motor Schedule or specifications. The Electrical Contractor is responsible for furnishing and installing all such control wiring as indicated on the Motor Schedule, even if not shown on the plans. The Electrical Contractor is

also responsible for the proper electrical operation of all items on the Motor Schedule, such as correct rotation of motors, correct heater sizes, etc.

- 3.3 Provide all connections to motors, and other equipment subject to vibration, with a flexible conduit connection. Use jacketed weatherproof flexible conduit, equal to Sealtite, for motors installed in a damp or wet location. Flexible conduit shall be installed in sufficient length and with enough slack to preclude transmission of vibration.
- 3.4 All starters shall be installed less overload heaters. The Electrical Contractor shall review the motor nameplates for the full load amps. When all nameplate full load amps have been recorded, the overload heaters shall be ordered and installed. Any starters that are installed with overload heaters prior to the nameplate full load amps being available shall, if required, be changed by the Electrical Contractor at no additional cost to the Owner.

END OF SECTION 260150

SECTION 260160 – SAFETY SWITCHES**PART 1 - GENERAL****1.1 GENERAL**

- A. This section covers Safety Switches.
- B. Furnish and install safety disconnect switches where indicated on the drawings, in the equipment schedules and as specified elsewhere herein.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 RELATED SECTIONS

- A. Fuses are covered in Section 260180, LOW VOLTAGE FUSES.
- B. Individually-mounted starters are covered in Section 260150, Motors and Motor Controls.
- C. Refer to Section 260010, Basic Electrical Materials and Methods, for Nameplates.

1.4 QUALITY ASSURANCE

- A. Switches shall be Underwriter's Laboratories, Inc., listed, and shall meet Federal Specification WS-865c and NEMA Specifications KS1.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Safety Switches shall be as manufactured by Square D, Eaton, ABB/GE or Siemens.

2.2 SAFETY SWITCHES

- A. Disconnect safety switches shall be single-throw, positive quick-make, quick-break contact mechanism, fusible or non-fusible as indicated, heavy duty, horsepower rated, dead front, and front accessible. The switch handle shall physically indicate the ON and OFF positions. Such handles shall also be able to accept a padlock having heavy duty industrial type shackles, and be padlocked either in the ON or the OFF position. Covers shall be interlocked with the switch handles to prevent opening in the ON position. An interlock override device shall be provided to allow authorized personnel to release the interlock for inspection purposes when the switch is in the ON position. Switch ampere rating and number of poles shall be as indicated on the drawings or as required. Fuse clips shall be positive pressure cartridge type and shall accommodate the classification of fuses as indicated on the drawings and/or as specified.
- B. The disconnect handle shall be attached to the box or enclosure base, and not to the cover. Terminal lugs shall be Underwriter's Laboratories listed for copper and aluminum cables and shall be front removable. All current carrying parts shall be plated by electrolytic processes.
- C. Switch enclosures for indoor locations shall generally be NEMA 1 heavy duty, code gauge sheet steel. Switches located outdoors or in wet locations shall be NEMA 3R rain tight, code gauge

galvanized steel and are identified on the drawings as weatherproof (WP). Exterior switches located at cooling towers shall be NEMA 4 watertight, stainless steel. Switches located in food service preparation and dishwashing areas shall be NEMA 4 watertight, stainless steel. Switches located in hazardous areas shall have enclosures of the proper NEMA type construction for the location and application and will be so indicated on the drawings. Enclosures shall meet Underwriter's Laboratories Standard 98, and shall be treated with a rust-inhibiting phosphate and finished in gray baked enamel paint.

- D. Heavy duty switches shall have permanently attached arc suppressors hinged or otherwise attached to permit easy access to line-side lugs without removal of the arc suppressors.
- E. Switches used in circuits having a neutral conductor shall be provided with an insulated (isolated) groundable solid neutral terminal bar.
- F. Provide auxiliary contacts in all safety switches. Auxiliary contacts shall be (2) N.O. and (2) N.C. form C type. Connect auxiliary contacts to VFD controls to shut down when circuit is opened for safety switches used with VFDs. Connect auxiliary contacts to elevator controller battery lowering device when circuit is opened for safety switches used with elevators.
- G. Provide an internally mounted ground bus kit labeled for copper or aluminum ground conductors in all safety switches.

PART 3 - EXECUTION

- 3.1 Properly align safety switches and adequately support independent of the connecting raceways. Provide steel straps and appurtenances necessary for the support of the equipment.
- 3.2 Furnish and install fuses in fusible safety switches where required. Verify rating of installed fuses.
 - A. Comply with NECA 1, NEMA PB1.1 and PB 2.1.
 - B. Install wall mounted switches with tops at uniform height, unless noted otherwise.
 - C. Install fuses so ratings are readable in the installed position.
- 3.3 On completion of installation, vacuum dirt and debris from interiors. DO NOT use compressed air to assist in cleaning.
- 3.4 Provide arc flash warning labels for safety switches per section 260055, "Arc Flash Hazard Analysis, Short Circuit, and Coordination Study" or as indicated on plans.

END OF SECTION 260160

SECTION 260190 - SUPPORTING DEVICES**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 REFERENCES

- A. NECA 101- "Standard for Installing Steel Conduit (Rigid, IMC, EMT)."
- B. ANSI/NFPA 70 - National Electrical Code.
- C. Refer to 260025, SEISMIC RESTRAINTS Section for additional requirements.

PART 2 - PRODUCTS**2.1 Materials and Finishes: Provide adequate corrosion resistance.****2.2 Provide material, sizes and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products. System shall be adequate in tension, shear and pullout forces to resist maximum loads calculated or imposed with a minimum structural safety factor of four times the applied force. Minimum static design load shall be the weight of supported components, plus 200 lbs.****2.3 Anchors and Fasteners:**

- A. Concrete structural elements: Use expansion anchors.
- B. Steel structural elements: Use beam clamps, spring steel clips, steel ramset fasteners, or welded fasteners.
- C. Concrete surfaces: Use self-drilling anchors and expansion anchors.
- D. Hollow masonry, plaster, and gypsum board partitions: Use toggle bolts and hollow wall fasteners.
- E. Solid masonry walls: Use expansion anchors.
- F. Sheet metal: Use sheet metal screws.
- G. Wood elements: Use wood screws.

2.4 Steel strut framework: Provide 12 gauge minimum size framework similar and equivalent to B-line or Unistrut for supporting electrical enclosures where noted or where necessary for a rigid installation.**PART 3 - EXECUTION**

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation", NECA 1 and 101. Space supports as scheduled in NECA 1 where Table 1 lists maximum spacings less than those listed in NFPA 70.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not drill or cut structural members.
- E. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- F. Install surface-mounted equipment enclosures with minimum of four anchors.
- G. In wet and damp locations use steel channel supports to stand equipment enclosures one inch off wall.
- H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- I. Install trapeze-type supports fabricated with steel slotted support system. Secure raceways to supports with two-bolt conduit clamps.
- J. Cast anchor bolts into concrete housekeeping bases and anchor equipment. Install anchor bolts per equipment manufacturer's setting drawings, templates, diagrams, instructions and directions at required elevations.

END OF SECTION 260190

SECTION 260432 – SERVICE PANELBOARD**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes low-voltage power service and distribution panelboards and associated auxiliary equipment rated 600 V or less.

1.3 QUALITY ASSURANCE

- A. Provide panelboard assemblies that are listed and labeled as defined in the National Electrical Code, Article 100. Service Panelboards shall meet NEC Article 110 Requirements for Electrical Installation and Article 408 Switchboards and Panelboards.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA Standard: Comply with NEMA Standard PB2, "Deadfront Distribution Panelboards."
- D. UL Standard: Comply with UL 891, "Deadfront Panelboards."
- E. Comply with NECA 407, "Recommended Practice for Installing and Maintaining Panelboards."
- F. Product Selection for Restricted Space: The Drawings indicate dimensions for panelboard equipment including clearances between panelboard and adjacent surfaces and items. Provide panelboards which have equal performance characteristics and which comply with indicated dimensions.
- G. Panelboard shall be UL listed and labeled for use as service entrance equipment.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store so condensation will not occur on or in panelboards. Provide temporary heaters as required to assure avoiding condensation.
- C. Handle panelboards in accordance with NEMA Standard PB2.1, "General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Panelboards." Use factory-installed lifting provisions.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D Co., Schneider Electric
2. Siemens Energy & Automation, Inc.
3. ABB/GE
4. Eaton

B. FABRICATION

1. The panelboard framework shall be fabricated on a die-formed steel base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. Alternately, panel can be wall or strut mounted. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all coverplates, bussing, and component devices during shipment and installation. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. Wireways, and sides and rear, shall have removable bolt-on or screw-on cover panels. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.
2. The panelboard bus shall be either copper or tin-plated aluminum of sufficient cross-sectional area to continuously conduct rated full load current with a maximum temperature rise of 65 degrees C. The bus bars shall have minimum short circuit bracing of 50,000 RMS amps symmetrical or as indicated on the one-line diagram. Neutral busses shall be the same size and material as the phase busses. Panelboard shall be provided with a copper ground bus, which shall be bonded to the panelboard enclosure.

2.2 ENCLOSURE

- A. Type 1 building interior locations.
- B. Type 3R building exterior locations. NEMA-3R non-walk-in, sloped roof.
- C. Sections shall be aligned front and rear. Front covers shall be hinged and latched with provisions for pad locking.
- D. The panelboard enclosure shall be painted on all exterior surfaces. The paint finish shall be medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
- E. Provide with front covers that shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
- F. Top and bottom conduit areas shall be clearly indicated on shop drawings.

2.3 UTILITY METERING COMPARTMENT

- A. The utility current transformers shall be located in a separate outdoor enclosure.

2.4 OVERCURRENT DEVICES

- A. Switches 800 amperes and less shall be quick-make, quick-break and suitable for use on the service as described for the sizes as shown on the associated drawings. The units, where applicable, shall be horsepower rated for dual-element fuses. The fusible switches shall be

group mounted in panel-type construction. Each switch is to be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses which shall be interlocked 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 released with a standard electrician's tool for testing fuses without interrupting service. The units shall have padlocking provisions in the OFF position and the operating handle position shall give positive position indication, i.e., horizontal OFF, diagonal ON.

- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents:
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
 - 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the sizes, number, ratings and conductor material as indicated on the drawings.
 - c. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.

2.5 INSTRUMENTATION

- A. Multifunction Digital Metering: UL listed or recognized microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Inputs: From sensors or current transformers from 100/5 through 5000/5 ratings and potential transformers up to 600 V.
 - 2. Display: Switch selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase currents, each phase.
 - b. Phase-to-phase voltages, 3 phase.
 - c. Phase-to-neutral voltages, 3 phase.
 - d. Watts.
 - e. VA.
 - f. Vars.
 - g. Power factor.
 - h. Frequency.

- i. Megawatt demand with demand interval programmable from 5 to 60 minutes.
 - j. Accumulated energy, megawatt hours.
 - k. Accumulated values unaffected by power outages up to 72 hours.
 - l. Alarm functions, including voltage and current loss, etc.
- 3. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.
- B. Multifunction Digital Meter shall be Cutler-Hammer IQ 4130, or one of the following products of equal characteristics:
 - 1. Square D Power Logic
 - 2. ABB/GE Power Leader
 - 3. Siemens Power Meter

2.6 QMBIMA SURGELOGIC SPD UNIT

- A. The internally mounted SPD shall be mounted in the Service Panelboard.
- B. SPD shall be listed in accordance with UL 1449 Second Edition to include Section 37.3 highest Short Circuit Current Rating (SCCR) of 200 KA.
- C. SPD shall be tested with the ANSI/IEEE Category C3 high exposure waveform (20kV-L2/50us. 10kA-8/20us.).
- D. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
- E. The manufacturer for the SPD shall be the same as the manufacturer of the service entrance and distribution equipment shall be fully tested and certified to the following UL standards:
 - 1. UL 67 = Panelboards,
 - 2. UL 845 = Motor Control Centers,
 - 3. UL 857 = Busway,
 - 4. UL 891 = Switchboards,
 - 5. UL 1558 = Low Voltage Switchgear.
- F. Each SPD mode, including N-G, shall be fused with a 200 kAIR, UL recognized surge rated fuse and incorporate a thermal cutout device. SPD shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200kA, including low level fault currents from 5 to 5000 amperes.
- G. SPD ratings:
 - 1. Minimum surge current rating shall be 320kA per phase (160 kA per mode) for service entrance.
 - 2. UL 1449 clamping voltage must not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
208Y/120	400V	400V	400V
480Y/277	800V	800V	800V

3. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE Category C3 transients without failure or degradation of clamping voltage by more than 10%.
 - H. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
 - I. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
 - J. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
 - K. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.
 - L. Terminals shall be provided for necessary power and ground connections.
 - M. The SPD shall be equipped the following optional items:
 1. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.
 2. A remote monitoring device shall be provided to directly connect to the SPD with a dry contact connector for simple installation. The device will have indicator lights and an audible alarm to monitor for normal and fault conditions.
 - N. SPD shall have a warranty for a period of five (5) years from date of invoice. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.
- 2.7 RATINGS
- A. System voltage, continuous main bus amperage and short-circuit-current ratings shall be as indicated on the drawings.
- 2.8 NAMEPLATE
- A. Provide black plastic nameplate with 3/16" white letters showing panelboard designation, voltage and ampere ratings, short circuit ratings and manufacturer's name and sales order number.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install panelboards and accessory items in accordance with manufacturers' written installation instructions and applicable codes and standards.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels and brackets and temporary blocking of moving parts from panelboard units and components.
- C. Provide the necessary support system to satisfy the requirements of the seismic region indicated on the drawings.

3.2 CONCRETE PAD

- A. Provide a 4" high concrete pad for the service panelboard, if floor mounted.

3.3 GROUNDING

- A. Connections: As indicated. Tighten connections to comply with tightening torques specified in UL 486A and 486B.
- B. Ground equipment to main electrical ground bus indicated. Provide minimum 5-ohm ground resistance at panelboard location.

3.4 CONNECTIONS

- A. Tighten panelboard bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Upon completing installation of the system, perform the following tests:
 - 1. Make insulation resistance tests of panelboard buses, components and connection supply, feeder and control circuits.
 - 2. Make continuity tests of circuits.
- B. Visual and Mechanical Inspections: Include the following inspections and related work:
 - 1. Inspect for defects and physical damage, testing laboratory, labels and nameplate compliance with up-to-date circuit connections.
 - 2. Verify that potential transformers, including their overcurrent protection and current transformers meet specified requirements.
 - 3. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - 4. Check panelboard anchorage, area clearances and alignment and fit of components.
 - 5. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
- C. The contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study. Field settings of devices adjustments and minor modifications to

equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

3.6 CLEANING

- A. Upon completion of installation, clean interior and exterior of panelboards. Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars of finish to match original finish.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each section of panelboards throughout periods during which the panelboard is not in a space that is continuously under normal control of temperature and humidity.

- 3.8 Provide arc flash warning labels for panels per section 260055, "Arc Flash Hazard Analysis, Short Circuit, and Coordination Study" or as indicated on plans.

END OF SECTION 260432

SECTION 260455 – GROUNDING SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits and systems. Grounding requirements specified in this section may be supplemented in other sections of these specifications.

1.3 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 grounding rods, connectors and connection materials, and grounding fittings.
- C. Field tests and observation reports indicating and interpreting the test reports for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with UL 467.
- C. Listing and Labeling: Provide products specified in this section that are UL listed and labeled.
- D. Comply with NECA 331, "Standard for Building and Service Entrance Grounding and Bonding."

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chance: A. B. Chance Co.
 - 2. Erico, Inc.; Electrical Products Group
 - 3. Ideal Industries, Inc
 - 4. ILSCO
 - 5. O-Z/Gedney Co.
 - 6. Raco, Inc
 - 7. Thomas & Betts

2.2 GROUNDING AND BONDING PRODUCTS

- A. Governing Requirements: Where types, sizes, ratings and quantities indicated are in excess of National Electrical Code requirements, the more stringent requirements and the greater size, rating and quantity indications govern.

- B. Grounding Bus: Rectangular bar of annealed copper with tapped holes and insulated spacers.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Division 26 Section 260120, "Conductors". Conform to NEC Article 250, except as otherwise indicated, for conductor properties, including stranding.
- B. Material: Use only copper wire for both insulated and bare grounding conductors and similar materials.
- C. Equipment Grounding Conductors: Insulated with green color insulation, Type THW, THHN or THWN insulation.
- D. Grounding-Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.
- F. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.4 MISCELLANEOUS CONDUCTORS

- A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.
- C. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, except as indicated.

2.5 CONNECTOR PRODUCTS

- A. Pressure Connectors: High conductivity plated units.
- B. Bolted Clamps: Heavy duty type or Hammer Lock. Acorn clamps are not acceptable.
- C. Exothermic-Welded Connections: Cadweld type, provided in kit form and selected per manufacturer's instructions.

2.6 GROUND RODS

- A. Copper-Plated Steel: 3/4" diameter, 10'-0" long.

PART 3 - EXECUTION

3.1 GENERAL

- A. The entire electrical system and all electrical equipment shall be grounded in strict accordance with the National Electrical Code and as shown on the drawings.

- B. The grounding system shall be continuous throughout the electrical system. Route along shortest and straightest paths possible. Avoid obstructing access or installing where they may be subjected to strain, impact or damage.
- C. Neutral conductors shall be continuous throughout the electrical system and shall be grounded only at the service neutral at the service switch, or at the center point of a transformer secondary winding for a separately derived system as indicated on the drawings.
- D. When the service entrance switch or switchboard has a neutral bus bar, this bus bar shall be bonded to the ground bus bar in the service entrance or switchboard.
- E. When a steel conduit contains only ground wires, the ground wires shall be bonded to the conduit at both ends of the conduit run.
- F. Service and equipment grounds to the water system piping shall be made using an approved clamp installed in an accessible location. Provide jumpers around water meters and insulated pipe connections.
- G. Cabinets, panels, boxes, appliance frames, conduits and other non-current carrying metallic objects shall be grounded as required by the National Electrical Code.
- H. Install metallic raceways mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment.
- I. Refer to Section 260010 - BASIC ELECTRICAL MATERIALS AND METHODS for Grounding Continuity tests required.
- J. Underground ground rod, UFER concrete encased grounding electrode, and building steel connections shall be made with exothermic welds.

3.2 APPLICATION

- A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes and quantities of equipment grounding conductors, except where specific types, larger sizes or more conductors than required by NEC are indicated.
 - 1. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:
 - a. Feeders and branch circuits.
 - b. Receptacle circuits.
 - c. Single-phase motor or appliance branch circuits.
 - d. Three-phase motor or appliance branch circuits.
 - e. Flexible raceway runs.
 - f. Armored and metal-clad cable runs.
- B. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- C. Bonding conductors: Provide bonding conductors between panelboard busses where patient care areas are fed from different panels in accordance with NEC 517.14.

3.3 SEPARATELY DERIVED SYSTEMS

- A. The secondary windings of transformers constitute a separately derived system. A bonding jumper shall be used to connect the equipment grounding conductors of the separately derived system, ahead of any system disconnecting means or overcurrent device.
- B. A grounding electrode conductor shall be used to connect the grounded conductor of the separately derived system to the grounding electrode. This connection shall be made at the source of the separately derived system and ahead of any system disconnecting means or overcurrent device.

3.4 EMERGENCY GENERATOR GROUNDING

- A. The emergency power generation system is NOT a separately derived system by virtue of the 3-pole transfer switches which do not switch the neutral (grounding conductor). Do not install a separate system ground electrode for the emergency generator.
- B. Connect the emergency generator to the equipment ground system as required by the National Electrical Code.
- C. Remove the neutral bonding jumper and do not ground the neutral at the generator, nor at any point between the generator and the service.

3.5 GROUNDING OF SPECIAL SYSTEMS

- A. Furnish and install a green size 6 AWG copper wire in 1/2" conduit from the data terminal board and incoming telephone service to the main switchboard ground bus. The point of connection shall be located so that it is normally visible for inspection. Provide a Telecommunications Main Grounding Busbar (TMGB) equivalent to Erico TMGB - A14L15PT at terminal boards; mount TMGB at 24" AFF and terminate #6 AWG ground conductor to it.
- B. Provide a green #6 AWG copper wire in 1/2" conduit from the Fire Alarm Control Panel to the main switchboard ground bus.
- C. Provide an equipment ground bus adjacent to the service panelboard and provide bonding conductors from this bus to service ground, FACP, IDFs, Security System, Access Control System, CATV, Satellite, and all other special systems.

3.6 SYSTEM GROUNDING ELECTRODE

- A. The grounding electrode shall be as near as practicable to, and preferably in the same area as, the grounding conductor connection to the system.
- B. A metal underground water pipe, the metal frame of the building, a concrete-encased electrode and a ground ring electrode (where present) shall be bonded together to form the grounding electrode system.
- C. Where none of the above electrodes is available, the grounding electrode shall be a "Made Electrode" as per Section 250.52 of the National Electrical Code.

- D. Where a metal underground water pipe is the only grounding electrode available, it shall be supplemented by one of the grounding electrodes specified in Section 250.52 of the National Electrical Code.
- E. A single electrode which does not have a resistance to ground of 15 ohms or less shall be augmented by one additional electrode of any of the types specified in Section 250.52 of the National Electrical Code.

3.7 EQUIPMENT GROUNDING

- A. Provide an equipment bonding jumper from the grounding terminals of switches and receptacles to the grounded box that they are mounted in, unless the device is listed for self-grounding.
- B. At motors, connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted solderless lug. Bolts, screws and washers shall be bronze or cadmium plated steel.
- C. Provide a flexible bonding strap, No. 6 AWG equivalent, across each flexible duct connection at each air handler, exhaust fan, supply fan, etc., and install to preclude vibration.
- D. Exposed non-current-carrying metal parts of transformer installations shall be connected to the equipment grounding system.
- E. Provide a flexible bonding strap, #6 AWG or equivalent, to each water heater and other piece of plumbing equipment that may become energized.

END OF SECTION 260455

SECTION 260460 – DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section covers dry-type transformers for application at 600V or less.
- B. Furnish and install dry-type transformers sized in accordance with the transformer schedule and/or notes shown on the drawings.

1.3 QUALITY ASSURANCE

- A. Comply with the following standards:
 - 1. NFPA 70
 - 2. IEEE C57.12.91
 - 3. UL 1561
 - 4. DOE 10 CFR 431
 - 5. NEMA Standard ST-20 "Dry-Type Transformers for General Application."
 - 6. NECA 409, "Standard for Installing and Maintaining Dry-Type Transformers."

1.4 SUBMITTALS

- A. Product Data: Nameplate Data, capacities, weights, and dimensions for each type and size indicated.
- B. Tap settings and test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Dry-type transformers shall be as manufactured by:
 - 1. Square D
 - 2. Cutler-Hammer
 - 3. ABB/GE
 - 4. Siemens
 - 5. Sola/Heavi-Duty Electric

2.2 DRY TYPE TRANSFORMERS

- A. Dry-type transformers shall be three-phase, 60 hertz, two-winding, 480V delta primary to 120/208V three-phase, four-wire wye secondary with grounded neutral.
- B. Taps

1. Transformers 15 KVA or smaller shall have two 5% FCBN (full capacity below normal) primary taps. Transformers larger than 15 KVA shall have two 2-1/2% FCAN (full capacity above normal) and four 2-1/2% FCBN primary taps.
- C. Windings: Aluminum or copper.
- D. Insulation
1. All insulating materials are to exceed NEMA ST20 standards and be rated for 220°C UL component recognized insulation system.
 2. Transformers 15KVA and larger shall be rated for 150°C temperature rise above 40°C ambient.
 3. Transformers over 112 ½ KVA shall be provided with class 155 or higher insulation systems and shall be completely enclosed except for ventilation openings.
 4. Fan cooled transformers are not acceptable.
- E. Sound Rating
1. Sound levels shall be warranted by the manufacturer not to exceed the following:
- | <u>KVA</u> | <u>DECIBELS</u> |
|-------------|-----------------|
| 15 – 50 | 45 |
| 51 – 150 | 50 |
| 151 – 300 | 55 |
| 301 – 500 | 60 |
| 501 – 700 | 62 |
| 701 – 1000 | 64 |
| 1001 – 1500 | 65 |
| 1501 – 2000 | 66 |
- F. Enclosure
1. Indoor Type: Ventilated, drip-proof NEMA 2. Transformers shall be completely enclosed except for ventilation openings.
- G. Minimum Efficiency
1. Transformers shall be low loss type with minimum efficiencies per DOE 10 CFR 431 when operated at 35% of full load capacity. Efficiency shall be tested in accordance with DOE 10 CFR 431.

Single Phase

<u>KVA</u>	<u>EFFICIENCY</u>
15	97.70%
25	98.00%
37.5	98.20%
50	98.30%
75	98.50%
100	98.60%
167	98.70%

Three Phase

<u>KVA</u>	<u>EFFICIENCY</u>
15	97.89%
30	98.23%
45	98.40%
75	98.60%
112.5	98.74%
150	98.83%
225	98.94%

250	98.80%	300	99.02%
333	98.90%	500	99.14%
		750	99.23%
		1000	99.28%

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Conduit connections at the transformers shall be made using flexible steel conduit.
- B. Arrange equipment to provide adequate spacing for access and for cooling air circulation.
- C. Identify transformers and install warning signs according to Division 26 Section "Basic Electrical Materials and Methods."
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A and UL 486B.

3.2 CONCRETE PAD

- A. Provide 4" high concrete pad for each floor mounted dry-type transformer.

3.3 GROUNDING

- A. Ground transformers and systems served by transformers according to Division 26 Section "Grounding System."

3.4 TESTING

- A. Tests: Include the following minimum inspections and tests according to the manufacturer's instructions. Conform to IEEE Standard Test Code C57.12.91 for dry-type units, test method, and data correction factors.
 - 1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.
 - 2. Include internal inspection through access panels and covers.
 - 3. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL standards 486A and 486B.
 - 4. Insulation Resistance: Perform megohmmeter test of primary and secondary winding-to-winding and winding-to-ground.
 - 5. Test Failures: Correct deficiencies identified by tests and retest. Verify that equipment meets the specified requirements.

3.5 ADJUSTING

- A. After completing installation, cleaning and testing, touch up scratches and marks on finish to match original finish.

- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout the normal operating cycle of the facility. Record voltages and tap settings to submit with test results.

END OF SECTION 260460

SECTION 260470 - PANELBOARDS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section covers circuit breaker lighting and appliance panelboards, power circuit breaker panelboards and fusible panelboards.

1.3 QUALITY ASSURANCE

- A. Panelboards shall comply with the requirements of the National Electrical Code, NEMA, ANSI, IEEE and OSHA. Panelboards shall bear the Underwriter's Laboratories Label.
- B. Comply with NEMA Standard PB1, "Panelboards".
- C. Comply with UL Standards 67, "Panelboards" and UL50, "Cabinets and Boxes".
- D. Comply with NECA 407, "Recommended Practice for Installing and Maintaining Panelboards."

1.4 SUBMITTALS

- A. Product Data: For each panelboard and overcurrent protective device, including dimensions, ratings, finishes and components.
- B. Panelboard Schedule: Typewritten for installation in panels.
- C. Time-current curves for each overcurrent protective device.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Provide panelboard products of one of the following:
 - 1. Square D Co., Schneider Electric
 - 2. Eaton
 - 3. ABB/GE
 - 4. Siemens Energy and Automation, Inc.

2.2 CIRCUIT BREAKER LIGHTING AND APPLIANCE PANELBOARDS

- A. Panelboards shall be dead front safety type equipped with circuit breakers. Each panelboard shall have an integrated short circuit withstand rating equal to the short circuit interrupting capacity of the circuit breakers. Panelboard bus structure and main lugs or main circuit breaker shall have current and voltage ratings and number of phases, poles, and wires as indicated on the drawings.

- B. Circuit breakers shall be quick-make, quick-break, bolt-on type having over-center toggle mechanisms with thermal-magnetic trips and shall be trip free. Multi-pole circuit breakers shall have common trips and a single operating handle. Handle tie bars will not be accepted. Circuit breakers shall be provided with a means for indicating a tripped position, and shall be capable of being locked in the open position. Branch circuit breakers shall be replaceable without disturbing adjacent units. Circuit breaker voltage, ampere rating, interrupting rating and number of poles shall be as indicated on the drawings. Circuit breakers shall have a minimum short-circuit interrupting capacity of 10,000 amperes RMS for 120/208V panels and 14,000 amperes RMS for 277/480V panels. Circuit breakers shall be equipped with individually insulated, braced, and protected connectors.
1. Circuit breakers for switching fluorescent lighting circuits at panelboards shall be type SWD.
 2. Circuit breakers for equipment marked HACR Type shall be HACR type.
 3. Circuit breakers with shunt trip feature shall be 120V A.C. trip voltage.
 4. Circuit breakers with arc fault protection shall be AFCI type.
 5. Circuit breakers with ground fault protection shall be GFCI type (5mA).
 6. Circuit breakers with equipment ground fault protection shall be EPD type (30mA).
- C. UL class A (5 milliampere sensitivity) and Class B (30 milliampere sensitivity) ground fault circuit protection shall be provided on 120 VAC branch circuits as shown on the plans or in the panelboard details. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional single pole circuit breaker.
- D. The panel box shall be fabricated from code gauge galvanized steel. Unless otherwise indicated, panelboards shall be standard width with boxes having a minimum width of 20 inches and a maximum depth of 5-3/4 inches.
- E. The panelboard front shall be surface or flush mounted as indicated on the drawings, fabricated from cold-rolled steel, coated with rust-inhibiting primer, finished with ANSI-61 light gray baked-on enamel paint, and shall have a door equipped with concealed hinges, a semi-flush or flush lock requiring a milled key, a framed directory card with a clear plastic covering mounted on the inside of the door. At least two keys shall be provided with each panelboard and all panelboard locks shall be keyed alike. The panelboard front shall be fastened to the panel box with machine screws or other approved fastening hardware and shall not be removable with the door in the closed position.
- F. Interiors shall be equipped with bussing, circuit breakers, and adjustable means for positioning the interior within the enclosure.
- G. Main bus and circuit breaker branch bus shall be copper having 98% conductivity. Aluminum bus shall not be acceptable. Full size neutral busses shall be insulated from the panelboard. The location of the main terminations shall be determined by the entrance of the feeders to the panelboard enclosure. In those cases where the feeders pass through the panelboard assembly, extra wide gutters shall be provided.

- H. Double width panels: Where required or otherwise indicated, provide two panelboards under single front, each section with separate door and each section with similar space configuration, unless specified to be single width panel.
- I. The panelboard interior shall be provided with a ground bus, which shall be bonded to the panelboard enclosure. Provide separate isolated ground bus where indicated, or where required.
- J. The neutral bus and the ground bus shall be provided with an individual terminal or lug for each wire connected to it.
- K. Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified. Terminal for branch circuit wiring, both breaker and neutral shall be UL listed as suitable for the type of conductor specified.
- L. Bussing sequence shall be distributed phase sequence type. Bus sequence shall start at the top left phase bus of the interior for both top and bottom feed panels. Provisions or spaces for future breakers shall be located at the bottom of the panel and be fully bussed complete with all necessary mounting hardware less the breaker. Locate next to each breaker, space, or provision an individual number permanently affixed to the panelboard. Numbering tape or painted numbers shall not be acceptable.
- M. The inside of the panel or door shall have a printed nameplate indicating the name of the panel manufacturer, shop order number, panel type, system voltage and bus ampacity. Panel shall be marked with its UL short circuit withstand ratings.
- N. Circuit breaker lighting panelboards shall be Square D type NQ or NQOD, 120/208 volts, and Square D type NF, 277/480 volts or equal by General Electric, Eaton or Siemens.
- O. The circuit breakers supplied shall be tested and listed as fully rated. This short circuit current rating shall be marked on the panelboards and shall be equal to or greater than the short circuit current available, in compliance with NEC Sections 110-22 and 240-86.
- P. Load centers are not permitted unless specifically called out in the specification and on the drawings.

2.3 POWER CIRCUIT BREAKER PANELBOARDS

- A. Power circuit breaker panelboards shall be dead-front safety type. The panel, including all bus bracing, circuit breakers, and associated current carrying components, shall have a minimum integrated short circuit withstand rating of 42,000 amperes RMS symmetrical. The panel bus structure and main lugs or main switch shall have current and voltage ratings, and number of phases, poles, and wires as indicated on the drawings.
- B. Bus bars shall be copper or aluminum. Neutral busses shall be insulated from the panel. Main horizontal bussing shall be full size throughout without reduction. The bus structure shall accommodate bolted branch switches as indicated on the drawings without modification to the bus assembly. No additional lineside wiring shall be necessary to add breakers. Space for future circuit breakers shall be bussed for the maximum devices that can be fitted into them.

- C. Circuit breaker power panelboard shall be Square D type I-Line or equivalent from Eaton, GE or Siemens.

2.4 EXISTING PANELBOARDS

- A. Where drawings indicate existing panelboards are to be reused to serve electrical loads, comply with the following requirements.
- B. Existing circuit breaker panelboards.
 - 1. Replace any defective circuit breakers with new circuit breakers of the same trip rating, interrupting capacity and number of poles.
 - 2. Provide new circuit breakers when existing circuit breakers installed in the panelboard are not of the correct trip rating, interrupting capacity and number of poles to serve the new loads.
 - 3. Provide blank covers over any existing unused openings.
- C. Existing fusible panelboards
 - 1. Provide new fuses of the rating and size required to serve new loads.
- D. At any existing panelboard where work is performed, provide a ground bus if none exists.
- E. Provide new circuit directories. Provide new panel nameplate if there is no existing nameplate.

PART 3 - EXECUTION

- 3.1 General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- 3.2 Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."
- 3.3 Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish. Top of trim shall be 74" AFF, unless noted otherwise. Mount adjacent boxes with tops aligned.
- 3.4 Circuit Directory: Provide typed directory reflective of final circuit changes required to balance panel loads.
- 3.5 Install filler plates in unused spaces.
- 3.6 Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.
- 3.7 Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.
- 3.8 Wiring in Panel Gutters: Train conductors neatly in groups, bundle and wrap with wire ties after completion of load balancing.

- 3.9 Install panelboards with proper code required clearances at front of and above equipment. Coordinate with other trades prior to rough-in. Verify proper wall thickness for recessed panels.
- 3.10 Each panelboard shall have a black plastic nameplate with 1/4" white letters, indicating the panel number as shown on the drawings and source of supply per NEC 408-4 (B).
- 3.11 Install floor mounted panels on a 4" nominal height concrete housekeeping pad 1" larger in both dimensions than the equipment to be set. Provide steel reinforcing per ACI recommendations.
- 3.12 Provide seismic restraints for panels per section 260025, "Seismic Restraints" or as indicated on the plans.
- 3.13 Provide arc flash warning labels for panels per section 260055, "Arc Flash Hazard Analysis, Short Circuit, and Coordination Study" or as indicated on plans.

END OF SECTION 260470

SECTION 260475 – SURGE PROTECTIVE DEVICES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes surge protective devices for low-voltage power (< 1000 volts) equipment.
- B. Related sections include the following:
 - 1. Section 260140 - Wiring Devices, for devices with integral surge protection.
 - 2. Section 260430 - Switchboards, for locations that require installation at the Service Entrance Switchboard.
 - 3. Section 260470 - Panelboards, for locations that require installation at the panel or sub-panel level.
- C. The installation shall be in conformance with NEC Article 285.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, shipping, installed and operating weights, furnished specialties, and options. Include model number, type, system voltage, phases, modes of protection, voltage protection rating (VPR) and nominal discharge current (In).
- B. Product Certifications: Signed by manufacturers of surge protective devices, certifying that products furnished comply with the following testing and labeling requirements:
 - 1. UL 1449 5th Edition and UL 1283 listing and classifications. SPD shall bear the UL mark and shall be listed to UL 1449 5th Edition and most recent edition of UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
- C. Maintenance Data: For surge protective devices to include in maintenance manuals specified in Division 1.
- D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product must be made by a company engaged in the manufacture of such devices for a minimum of five years.
- B. Source Limitations: Obtain protective devices and accessories through one source from a single manufacturer.

- C. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Other manufacturers' products complying with requirements may be considered by the engineer/architect greater than 14 days prior to bid. Samples may be required for approval. Devices mounted integral to the switchboard or panelboard do not meet the intent of this specification.
- 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.
- E. IEEE Compliance: Comply with ANSI/IEEE C62.41-2002, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits" and test devices in accordance with ANSI/IEEE C62.45-2002, "IEEE Guide for Surge Suppressor Testing".
- F. UL Compliance: Comply with UL 1449 Rev. 3 "UL Standard for Safety for Surge Protective Devices" and UL1283 "Electromagnetic Filters".

1.5 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment or panelboards to their sources until the surge protective devices are installed and connected. Do not single phase, hi-pot or megger service entrance equipment without disconnecting the surge protective device, as damage to the surge protective device may result from these procedures.
- B. 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 Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum continuous operating voltage: Not less than 110% of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg. F
 - 3. Humidity: 0 to 95%, non-condensing.
 - 4. Altitude: Less than 12,000 feet above sea level.

1.6 COORDINATION

- A. Coordinate location of field mounted surge suppressors to allow adequate clearances for maintenance.
- B. Coordinate surge protective devices with Division 26 Sections "Electrical Power Monitoring and Control" and "Lightning Protection".

1.7 WARRANTY

- A. 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.
- B. Specialty Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within eight years (96 months) from date of Substantial Completion or 10 years (120 months) from date of manufacture. Warranty shall include parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements of this specification listed herein, provide products by one of the following manufacturers:
 - 1. Current Technology
 - 2. Emerson Network Power / Edco
 - 3. Advanced Protection Technologies
 - 4. Eaton Corporation
 - 5. Schneider Electric
 - 6. Siemens
 - 7. Surge Suppression Incorporated
- B. This specification is performance based, and any other vendors who desire approval to bid this project shall provide written documentation of any deviations from this specification, which shall be included in product submittal 14 days prior to bid.

2.2 SERVICE ENTRANCE SUPPRESSORS (TYPE 1)

- A. Surge protective device: The system shall be constructed using multiple surge current diversion thermally protected metal oxide varistors (TPMOVs). The surge current circuit shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable unless documentation from a nationally recognized laboratory demonstrates current sharing of all dissimilar components at all surge current levels.
- B. Product certifications: Products furnished comply with the following testing and labeling requirements: UL 1449 and UL 1283 listing and classifications including fault current rating to meet or exceed service entrance equipment.
- C. Maximum continuous operating voltage: 115% (or 125% at 120VAC) of nominal system operating voltage at 60 hz.
- D. Peak single impulse surge current capacity, in all modes. Data obtained from actual tests (per mode):
 - 1. Line to Neutral: 100,000 Amperes
 - 2. Line to Ground: 100,000 Amperes
 - 3. Neutral to Ground: 100,000 Amperes

- 4. Line to Line: 100,000 Amperes
 - E. Listed to UL 1449 5th Edition, Voltage Protection Ratings (VPR) shall not exceed:
 - 1. 277/480 volt wye - L-N 1200, L-G 1200, N-G 1200, L-L 1800
 - 2. 120/208 volt wye - L-N 800, L-G 800, N-G 800, L-L 1200
 - F. Nominal Discharge Current Rating (In): 20 kA.
 - G. Integral EMI/RFI filter for high frequency noise (10 kHz to 100 mHz) attenuation.
 - H. Features to include:
 - 1. LED indicator lights for power and protective status for each mode.
 - 2. Fault current UL tested and labeled for 100 kAIC.
 - 3. NEMA type 4, 4X, or 12 enclosure.
 - 4. Monitoring with audible alarm, including test and silence switch and form "C" alarm relay.
 - 5. SPD will have a warranty period as stated above with five (5) years of free replacement.
- 2.3 PANELBOARD SUPPRESSORS (TYPE 1 OR 2)
- A. Provide Type 1 suppressors at service entrance locations.
 - B. Surge protective device: The system shall be constructed using multiple surge current diversion thermally protected metal oxide varistors (TPMOVs). The surge current circuit shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable unless documentation from a nationally recognized laboratory demonstrates current sharing of all dissimilar components at all surge current levels.
 - C. Product certifications: Products furnished comply with the following testing and labeling requirements: UL 1449 5th Edition and UL 1283 listing and classifications including fault current rating to meet or exceed panelboard.
 - D. Maximum continuous operating voltage: Between 115% (or 125% at 120VAC) of nominal system operating voltage at 60 HZ.
 - E. Peak single impulse surge current capacity all modes. Data obtained from actual tests (per mode):
 - 1. Line to Neutral: 50,000 Amperes
 - 2. Line to Ground: 50,000 Amperes
 - 3. Neutral to Ground: 50,000 Amperes
 - 4. Line to Line: 50,000 Amperes
 - F. Listed to UL 1449 5th Edition, Voltage Protection Ratings (VPR) as follows:
 - 1. 277/480 volt wye - L-N 1,200, L-G 1,200, N-G 1,200, L-L 1800
 - 2. 120/208 volt wye - L-N 800, L-G 800, N-G 800, L-L 1200
 - G. Nominal Discharge Current Rating (In): 20 kA.

- H. Integral EMI/RFI filter for high frequency noise (10 kHz to 100 mHz) attenuation.
- I. Features to include:
 - 1. LED indicator lights for power and protective status for each mode.
 - 2. Fault current UL tested and labeled for 100 kAIC.
 - 3. NEMA type 3R, 4, 4X, or 12 enclosure.
 - 4. SPD will have a warranty period as stated above with five (5) years of free replacement.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Provide multi-pole, 60- amp (or as recommended by manufacturer) overcurrent protective device as a dedicated disconnect for the SPD at service entrance location, unless otherwise indicated on drawings.
- C. Install devices for service entrance and panelboards, as indicated per electrical drawings, with conductors between suppressor and points of attachment as short and as straight as possible. Do not exceed manufacturer's recommended lead length. Max length is 36 inches or less; If longer lengths are needed, provide premium low impedance cable equal to Current Technology High Performance Interconnect (HPI) or Emerson Network Power AccuGuide (ACG).
- D. Provide multi-pole, 30 amp (or as recommended by manufacturer) overcurrent protective device as a dedicated disconnect for the SPD at panelboard locations, unless otherwise indicated on drawings.
- E. Mount suppressor as close as possible to switchgear and panelboard point of connection. Do not mount internal to switchgear or panelboards to facilitate ease of future maintenance and/or replacement. Installer may reasonably rearrange OCPD location from that shown on drawing to ensure the shortest and straightest possible leads to SPD's.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field quality control testing:
 - 1. After installing the surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements. Verify service and separately derived system neutral-to-ground bonding jumpers per NEC.

2. Complete start-up checks and voltage verifications according to manufacturer's written instructions.
3. Perform visual and mechanical inspection on each unit. Certify that units are installed per manufacturer's recommendations.

B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

3.4 DEMONSTRATION

- A. Engage a manufacturer's representative to demonstrate proper operation of the system and to train owner's maintenance personnel in proper evaluation of suppressor condition and procedure to repair or replace defective devices.
1. Review operation and maintenance manuals.
 2. Review performance specifications of devices supplied to show they comply with specifications herein.
 3. Schedule training with Owner, through Architect or General Contractor, with at least seven days advance notice.
 4. Contractor shall provide letter to owner that states units are installed per manufacturer's recommended installation procedures and system is functioning properly and warranty is initiated.

END OF SECTION 260475

SECTION 260485 - CONTACTORS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section covers multi-pole lighting contactors for controlling branch lighting circuits, power full voltage contactors to switch heating loads, capacitors, transformers, and electric motors.

1.3 QUALITY ASSURANCE

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- C. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Lighting Contactors and Power Contactors
 - 1. Square D
 - 2. ABB/GE
 - 3. Siemens
 - 4. Eaton
 - 5. ASCO

2.2 MULTI-POLE LIGHTING CONTACTORS

- A. Description: NEMA ICS 2, magnetic lighting contactor. Square D Class 8903 Type L, Electrically Held.
- B. Configuration: Electrically Held, 3 wire control, unless otherwise indicated.
- C. Coil voltage: 120 volts, 60 hertz unless otherwise indicated. All lighting contactors shall be provided with separate control as standard.
- D. Number of poles shall be as called out on the drawings.
- E. Contact ampere rating shall be 30 ampere fluorescent lighting rating and 20 ampere tungsten lighting rating. Contacts shall be Silver-Cadmium-Oxide double break contacts.
- F. Enclosure: ANSI/NEMA ICS 6, Type 1 or 3R as indicated. Provide bolt-on conduit hubs for NEMA 3R enclosures.
- G. Accessories: Remote on - off selector switch Square D Class 9001, KYK 221 10 ampere, 600 volt maximum surface control switch.

2.3 POWER FULL VOLTAGE CONTACTORS

- A. Description: NEMA ICS 2 magnetic power Contactor. Square D Class 8502 Type S magnetic Contactor.
- B. Configuration: Electrically held 3 wire control unless otherwise indicated.
- C. Coil voltage: 120 volts 60 hertz unless otherwise indicated. All Power Contactors shall be provided with separate control as standard.
- D. Contactors: Shall be two (2) or 3 pole 208 volt or 460 volt and of ampere rating shown on the plans.
- E. Enclosure: ANSI / NEMA ICS-6 Type 1 or 3R as indicated. Provide bolt on conduit hubs for NEMA 3R enclosures.
- F. Accessories: Remote on-off selector switch Square D Class 9001 KYK 221 10 ampere 600 volt maximum surface control switch.

PART 3 - EXECUTION

- 3.1 Properly align contactors and adequately support independent of the connecting raceways. Provide steel straps and appurtenances necessary for the support of the equipment.
- 3.2 Furnish and install remote control switches as indicated on the drawings.

END OF SECTION 230485

SECTION 260500 – INTERIOR LIGHTING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260000 - Electrical General Conditions
- C. Section 260010 - Basic Electrical Materials and Methods
- D. Section 260025 - Seismic Restraints

1.2 SUMMARY

- A. Furnish and install new lighting fixtures as shown on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

- A. Fixtures and components shall be U.L. listed and meet applicable national and local code requirements for the particular application. Fixtures shall bear the UL label.
- B. Comply with applicable ANSI, UL and NEMA standards including, but not limited to, the following:
 - 1. Lamps: ANSI C82.11 and C82.4.
 - 2. NECA/IESNA 500, "Standard for Installing Indoor Lighting Systems."
 - 3. NEMA SSL-1-10, "Electronic Drivers for LED Devices, Arrays, or Systems."

1.4 SUBMITTALS

- A. Product Data: For each type of light fixture including dimensions, features, accessories, ballasts, lamps, weights and supports.

PART 2 - PRODUCTS**2.1 GENERAL**

- A. Lighting equipment is shown in the fixture schedule on the drawings to establish general requirements. The fixture manufacturers' catalog numbers are not to be construed as all inclusive. Equivalent products may be considered if submitted as a substitution request +prior to bid. Furnish and install accessories or hardware required for a complete installation. Light fixtures shall be equipped with proper accessories, lenses, louvers, reflectors, shields, hangers, clips, frames, lamps, ballasts, and other components essential for proper installation in or on walls, ceilings or other construction features, and shall be properly painted for protection and preservation appropriate to the place installed.
- B. Refer to the Room Finish Schedule on the Architectural drawings to verify the type of ceiling construction. Fixtures specified in the Fixture Schedule are based on the ceiling construction contemplated at the time of design. Final ceiling construction may be different than the type

specified. EC shall confirm the ceiling construction with the General Contractor and Owner's Representative prior to construction. Provide fixtures with the proper hardware for installation in or on the specified ceiling.

- C. All fixtures shall bear a U.L. Listing.

2.2 FIXTURES AND FIXTURE COMPONENTS

- A. Metal Parts: Free from burrs, sharp corners and edges along with any metal parts shall be painted after fabrication.
- B. Sheet Metal Components: Steel, except as indicated. Formed and reinforced to prevent warping and sagging.
- C. Doors, Frames and Other Internal Access: Smooth operating, free from light leakage under operating conditions and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position. Door frames shall have captive spring latches.
- D. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:
 - 1. White Surfaces: 70 percent
 - 2. Specular Surfaces: 80 percent
 - 3. Diffusing Specular Surfaces: 75 percent
 - 4. Laminated Silver Metalized Film: 90 percent
- E. Lenses, Diffusers, Covers and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 - 2. Lens Thickness: 0.125 inch (3mm) nominal; except where greater thickness is indicated.
- F. Finishes:
 - 1. Manufacturer's standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters and similar defects.
 - 2. Finish applied on metal surfaces after forming or fabrication.

2.3 LED LIGHT FIXTURES

- A. General
 - 1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
 - 2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant and Design Lights Consortium Qualified Products.
 - 3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.

- b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: = 0.95.
 - f. Total Harmonic Distortion: = 20%.
 - g. Comply with FCC 47 CFR Part 15.
- 4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 4100K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
 - e. Minimum luminaire efficacy of 85 lumens per watt.
- B. LED Downlights:
 - 1. Housing, LED driver, and LED module shall be products of the same manufacturer.
- C. LED Troffers:
 - 1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
 - 2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures shall be installed in accordance with manufacturer's recommendations, instructions contained herein or on the drawings and field conditions.
- B. Locations of fixtures, unless specifically dimensioned on the architectural or electrical plans, may be scaled from the plans and adjusted as required to meet job conditions.
- C. Locations of light fixtures on the electrical plans are diagrammatic. Refer to Architectural Reflected Ceiling drawings for dimensional data, location and reference data including work or other trades. Coordinate installation of lighting fixtures with those drawings.
- D. Provide necessary accessories required for the support or mounting of fixtures. Where necessary, provide bridging between structural members. No fixtures shall be supported directly from the ceiling tiles or from duct work, piping or work of other trades.
- E. Recessed fixtures shall be mounted with flanges tight to the finished ceilings. Provide drywall flanges for fixtures installed in drywall ceilings.
- F. Surface and suspended fixtures shall be securely mounted to the structural system, the ceiling superstructure, or to supporting members. Surface fixtures shall be mounted in proper alignment with the ceiling. Suspended fixtures shall be mounted from vertical supports. Swivel type hangers or sloped ceiling adapter cones shall be provided on sloping ceilings.

- G. Recessed fixtures shall be independently supported with a minimum of two metal channels spanning ceiling tees or ceiling support steel channels. No fixture shall be supported directly from the ceiling tile.
 - H. Support for Recessed and Semi-Recessed Grid-Type Fixtures: Units may be supported from suspended ceiling support system with support wires at opposite corners of the fixture attached to building structure and four (4) grid clips.
 - 1. Fixtures of Sizes Less than Ceiling Grid: Center in acoustical panel. Support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees. Do not support fixtures by ceiling acoustical panels.
 - I. Wall mounted fixtures shall be securely mounted with a minimum of two screws to the wall or to studs or framing within the wall to prevent the possibility of movement or misalignment.
 - J. Install remote mounted ballasts in a ventilated enclosure, which shall be secured to the building structure with vibration isolating mountings. Connections shall be thru flexible conduit. Ballasts shall be mounted in a manner which will promote heat transfer to the housing.
 - K. Adjustable fixtures shall be aimed as directed by the Architect and/or Engineer.
 - L. Install lamps in each fixture.
- 3.2 Prior to substantial completion, clean fixture lenses and reflectors and replace inoperative lamps. Replace or repair damaged or blemished fixtures.
- 3.3 SEISMIC SUPPORTS
- A. Recessed mounted lighting fixtures shall have seismic supports to meet the criteria listed on structural plans and IBC. Refer to Section 260025 - Seismic Restraints.
 - B. Recessed fixtures installed in lay-in ceilings shall be provided with four (4) earthquake clips for securing to the restrained Tee bars. If ceiling grid is not seismically restrained, provide two (2) 12 gauge support cables on opposite corners of the fixture attached to building structure above.
 - C. Recessed fixtures shall have support mounting rails screwed to the ceiling Tee bars.
- 3.4 FIELD TESTS
- A. Test emergency lighting by interrupting power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 260500

SECTION 260525 – EXTERIOR LIGHTING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes exterior lighting fixtures, lamps, ballasts, drivers, pole standards and accessories.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Submit Product Data describing fixtures, lamps, ballasts, poles and accessories. Arrange Product Data for fixtures in order of fixture designation. Include data on fixtures, poles, accessories, finishes and the following:
 - 1. Outline drawings indicating dimensions and principal features of fixtures and poles.
 - 2. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps. Include photometric plans indicating footcandle levels on site plan at a 10' x 10' grid.
 - 3. Wind Resistance Calculations: Certified by a registered professional engineer.
 - 4. Shop Drawings detailing nonstandard fixtures and poles and indicating dimensions, weights, method of field assembly, components and accessories.
 - 5. Anchor-Bolt Templates: Keyed to specific poles and certified by manufacturer.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL.
- B. Comply with ANSI C2.
- C. Comply with NECA/IESNA 501, "Standard for Installing Exterior Lighting Systems."

1.5 STORAGE AND HANDLING OF POLES

- A. General: Store poles on decay-resistant treated skids at least 12 inches (300 mm) above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.
- B. Metal Poles: Retain factory-applied pole wrappings until just before pole installation.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide the products specified in Lighting Fixture Schedule shown on drawings. Equivalent products manufactured by Gardco, Cooper, Hubbell, Kim, Lithonia and Widelite will be acceptable.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp edges and corners.
- B. Sheet Metal Components: Corrosion-resistant aluminum, except as otherwise indicated. Form and support to prevent warping and sagging.
- C. Housing: Rigidly formed, weather- and light-tight enclosures that will not warp sag or deform in use. Provide filter/breather for enclosed fixtures.
- D. Doors, Frames and Other Internal Access: Smooth operating, free from light leakage under operating conditions and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect ballast.
- E. Exposed Hardware Material: Stainless steel.
- F. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.

2.3 FIXTURE SUPPORT COMPONENTS

- A. Pole-Mounted Fixtures: Conform to AASHTO LTS-4.
- B. Wind-load strength of total support assembly, including pole, arms, appurtenances, base and anchorage, is adequate to carry itself plus fixtures indicated at indicated heights above grade without failure, permanent deflection or whipping in steady winds of 100 mi./h (160 km/h) with a gust factor of 1.3.
- C. Arm, Bracket and Tenon Mount Materials: Match poles' finish.
- D. Mountings, Fastenings and Appurtenances: Corrosion-resistant items compatible with support components. Use materials that will not cause galvanic action at contact points. Use mountings that correctly position luminaire to provide indicated light distribution.
- E. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts and bolt covers. Provide with bolt cover.
- F. Poles: Steel tubing conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi (317 MPa). Poles are one-piece construction up to 40 feet (12 m) in length and have access handhole in wall.

- G. Metal Pole Grounding Provisions: Welded 1/2-inch (12-mm) threaded lug, accessible through handhole.
- H. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate fixtures.
- I. Pole-Top Tenons: Fabricated to support fixture or fixtures and brackets indicated and securely fastened to pole top.
- J. Concrete for Pole Foundations: Comply with Division 3 Section "Cast-in-Place Concrete." Use 3000-psi (20.7-MPa) strength, 28-day concrete.
- K. Provide additional device and tapped holes as required for wiring devices, cameras and other equipment as called for on the project plans. Coordinate locations with applicable trades.

2.4 FINISHES

- A. Metal Parts: Manufacturer's standard finish, except as otherwise indicated, applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters and similar defects.
- B. Other Parts: Manufacturer's standard finish, except as otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set units plumb, square, level and secure according to manufacturer's written instructions and approved Shop Drawings.
- B. Provide necessary accessories required for the support or mounting of fixtures. Where necessary, provide bridging between structural members.
- C. Concrete Foundations: Construct according to Division 3 Section "Cast-in-Place Concrete."
 - 1. Comply with details and manufacturer's recommendations for reinforcing, anchor bolts, nuts and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
 - 2. Finish: Trowel and rub smooth parts exposed to view.
- D. Pole Installation: Use web fabric slings (not chain or cable) to unload, store, raise and set poles.
- E. Fixture Attachment: Fasten to indicated structural supports.
- F. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.
- G. Install wiring, wiring devices, cameras and appurtenances as required or indicated on project plans.

3.2 GROUNDING

- A. Ground fixtures and metal poles according to Division 26 Section "Grounding System."
 - 1. Poles: Install 10-foot (3-m) 3/4" diameter driven ground rod at each pole and connect ground rod to pole-mounted ground lug with #6 AWG solid bare conductor.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged fixtures and components.
- B. Tests and Observations: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source. Include the following:
 - 1. Check for intensity of illumination.
 - 2. Check for uniformity of illumination.
 - 3. Check for excessively noisy drivers.
 - 4. Adjust lamps and reflectors as required.
- C. Replace or repair damaged and malfunctioning units, make necessary adjustments and retest. Repeat procedure until all units operate properly.

3.4 ADJUSTING AND CLEANING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 260525

SECTION 260610 – STANDBY GENERATOR**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SCOPE

- A. Provide, install, and acceptance test a complete and operable Emergency/Standby electric generating system, including all devices and equipment specified herein, as shown on the drawings, or required for the service. Equipment shall be new, factory tested, and delivered ready for installation.

1.3 QUALITY ASSURANCE

- A. Comply with NECA / EGSA 404, "Standard for Installing Generator Sets."
- B. Comply with NFPA 110.
- C. Comply with UL 2200.
- D. EPA Certified for Stationary Emergency Applications.

1.4 SUBMITTAL

- A. Provide six sets of the following information for review:
 - 1. Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
 - 2. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
 - 3. Manufacturer's certification of prototype testing.
 - a. Manufacturer's published warranty documents.
 - 4. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
 - 5. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
 - 6. Manufacturer's installation instructions.

1.5 WARRANTY

- A. Shall be provided for all products against defects in materials and workmanship for one year period from the start-up date.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide equipment as manufactured by one of the following:

1. Cummins/Onan
2. Caterpillar
3. Rehlko
4. Generac

2.2 DIESEL ENGINE-GENERATOR SET

- A. 4-cycle, 1800 rpm, diesel engine generator set. Generator set ratings based on site conditions of 97 deg F ambient and 800 ft above sea level:
 1. Office building (Gen-1 and Gen-2): 300 kw, 438 kVA and 60 kw, 75 kVA
 2. Operations building (Gen-3): 350 kw, 375 kVA
 3. Vehicle Maintenance building (Gen-4): 150 kw, 188 kVA
- B. Prototype tests shall have been performed on a complete and functional unit; component level type tests will not substitute for this requirement. Prototype testing shall comply with the requirements of NFPA 110.
- C. Performance
 1. Voltage regulation shall be +/- 1.0 percent for any constant load between no load and rated load.
 2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
 3. The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
 4. Motor starting capability shall be a minimum kVA rating as listed above. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
 5. Generator set shall be EPA qualified to the current required tier rating.

2.3 ENGINE

- A. The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:
 1. An electronic governor system shall provide automatic isochronous frequency regulation.
 2. Skid-mounted radiator and cooling system rated for full load operation in 104 degrees F (40 degrees C) ambient as measured at the generator air inlet.
 3. An electric starter(s) capable of three complete cranking cycles without overheating.
 4. Positive displacement, mechanical, full pressure, lubrication oil pump.
 5. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

6. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element.
7. Replaceable dry element air cleaner with restriction indicator. Flexible supply and return fuel lines.
8. Engine mounted battery charging alternator, 37 ampere minimum, and solid-state voltage regulator.

2.4 AC GENERATOR

- A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 125 degrees C in a 40 degree C ambient. Alternator shall be provided with protection to prevent damage due to any external fault or overload condition.
- B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

2.5 ENGINE STATUS MONITORING

- A. The following information shall be available from a digital status panel on the generator set control:
 1. engine oil pressure (psi or kPA)
 2. engine coolant temperature (degrees F or C)
 3. engine oil temperature (degrees F or C)
 4. engine speed (rpm)
 5. number of hours of operation (hours)
 6. number of start attempts
 7. battery voltage (DC volts)

2.6 CONTROL FUNCTIONS

- A. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
- B. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
- C. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall

include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.

- D. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- E. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

2.7 ALTERNATOR CONTROL FUNCTIONS

- A. The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from misoperation 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 a threshold of 59 HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with alpha-numeric LED readout to indicate setting level.
- B. The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
- C. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
- D. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
- E. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
- F. An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
- G. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 10 VDC or more than 16 VDC. During engine starting, the low

voltage limit shall be disabled, and if DC voltage drops to less than 7 volts for more than two seconds a "weak battery" alarm shall be initiated.

2.8 ENGINE-GENERATOR SET CONTROL

- A. The NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The generator set mounted control shall include the following features and functions:
1. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 2. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 3. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power.
 4. Generator Set AC Output Metering. The generator set shall be provided with a metering set with the following features and functions:
 - a. Analog AC Voltmeter, dual range, 90 degree scale, 2% accuracy; Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy; Analog Frequency/RPM meter, 45-65 Hz, 1350-1950 RPM, 90 degree scale, +/- 0.6 Hz accuracy.
 - b. Seven position phase selector switch with OFF position to allow meter display of current and voltage in each generator phase. When supplied with reconnectable generators, the meter panel shall be reconnectable for the voltage specified.
- B. Generator Set Alarm and Status Display
1. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and any activated alarm or shutdown conditions. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on the display panel:
 - a. switch off (flashing)
 - b. low oil pressure (alarm)
 - c. low oil pressure (shutdown)
 - d. low coolant temperature (alarm)
 - e. high coolant temperature (alarm)
 - f. high coolant temperature (shutdown)
 - g. low coolant level (shutdown)
 - h. overcrank (shutdown)
 - i. overspeed (shutdown)
 - j. low fuel-daytank (alarm)
 - k. ground fault (alarm)(optional--when required by code or specified).

2. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

C. Engine Status Monitoring

1. The following devices shall be provided on the generator set control:
 - a. engine oil pressure gauge
 - b. engine coolant temperature gauge
 - c. engine operation hour gauge
 - d. battery voltage (DC volts).

D. Control Functions

1. The control system provided shall include a cycle cranking system, which shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods. Fail to start shall be indicated by operation of the over crank alarm indication lamp.

E. Alternator Control Functions

1. The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 59 HZ for 60 Hz machines.
2. Voltage adjusting rheostat, locking screwdriver type, to adjust voltage +/- 5% from rated value.
3. When required by National Electrical Code or indicated on project drawings, the control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay which will function correctly in system as installed.

F. Control Interfaces for Remote Monitoring

1. Provide the following features in the control system:
 - a. Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
 - b. One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.

2.9 BASE

- A. The engine-generator set shall be mounted on a heavy duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

2.10 GENERATOR SET AUXILIARY EQUIPMENT AND ACCESSORIES

A. Water Jacket Heater

- 1. Engine mounted, thermostatically controlled, water jacket heater for each engine. The heater shall be sized as recommended by the generator set manufacturer. Heater voltage shall be as shown on the project drawings. Provide proper power supply circuits for the heater as required for the voltage and load of the heater, connected to a normally served distribution circuit.

B. Vibration Isolation

- 1. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

C. Exhaust Silencer

- 1. Exhaust muffler shall be provided for each engine, size and type as recommended by the generator set manufacturer. The mufflers shall be residential grade. Exhaust system shall be installed according to the generator set manufacturers recommendations and applicable codes and standards.

D. Starting and Control Batteries

- 1. Starting battery bank, calcium/lead antimony type, 12 volt DC, sized as recommended by the generator set manufacturer, shall be supplied for each generator set with battery cables and connectors.

E. Generator Set Main Circuit Breaker

- 1. Generator main circuit breaker: Set-mounted and wired, UL listed, molded case type with electronic trip unit, rated, 3-pole, 600 volts and as indicated on the drawings. Submittals shall demonstrate that the circuit breaker 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.

F. Battery Charger

- 1. Provide battery charger, equalizer float-type, size and type as recommended by the generator set manufacturer. Provide 120 Volt circuit to battery charger and cables between battery charger and batteries.

G. Remote Annunciator

- 1. Provide and install a 20-light LED remote alarm annunciator with horn, located as shown on the drawings or in a location which can be conveniently monitored by facility

personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

- H. Provide a remote emergency power off switch and locate as indicated on plans.

2.11 OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATING HOUSING

- A. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electro coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:

1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
 - a. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
 - b. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
 - c. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
 - d. Salt Spray, per ASTM B117-90, 1000+ hours.
 - e. Humidity, per ASTM D2247-92, 1000+ hours.
 - f. Water Soak, per ASTM D2247-92, 1000+ hours.

- B. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

2.12 FUEL STORAGE

- A. Sub-base Fuel Storage Tank

1. Provide a dual wall sub-base fuel storage tank with sufficient capacity for 24 hours of run time at full rated load. The tank shall be constructed of corrosion resistant steel and shall be UL listed. The equipment, as installed, shall meet all local and regional requirements for above ground tanks.
2. Provide an overflow / rupture alarm in emergency tank basin to indicate fuel in basin and connect to remote annunciator panel.
3. The tank shall be filled with fuel prior to start up tests.

PART 3 - EXECUTION**3.1 EXECUTION****A. Installation**

1. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
2. Installation of equipment shall include furnishing and installing all interconnecting wiring between all equipment provided for the on-site power system.
3. Generator shall be installed on concrete housekeeping pad. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
4. Equipment shall be initially started and operated by representatives of the manufacturer.
5. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

3.2 FACTORY TESTS

- A. Generator set factory tests on the equipment shall be performed at rated load. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

3.3 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer. The Engineer shall be notified in advance and shall have the option to witness the tests.
- B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

3.4 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

END OF SECTION 260610

SECTION 260620 – TRANSFER SWITCHES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes automatic transfer switches rated 600 V.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections:
 - 1. Shop drawings or published product data for each transfer switch, including dimensioned plans, sections and elevations showing minimum clearances, conductor entry provisions; gutter space; installed features and devices and materials lists.
 - 2. Wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.
 - 3. Single-line diagrams of transfer switch units showing connections between automatic transfer switch, by-pass/isolation switch, power source and load, plus interlocking provisions.
 - 4. Operation and maintenance data for each type of product, for inclusion in Operating and Maintenance Manual specified in Division 1.
 - 5. Manufacturer's certificate of compliance to the referenced standards and tested short-circuit closing and withstand ratings applicable to the protective devices and current ratings used in this Project, as indicated and as specified in paragraph "Tested Fault Current Ratings."

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms experienced in manufacturing equipment of the types and capacities indicated and have a record of successful in-service performance.
- B. Emergency Service: Manufacturer shall maintain a service center capable of providing emergency maintenance and repairs at project site with an 8-hour maximum response time.
- C. Comply with NFPA 70, "National Electrical Code," for components and installation.
- D. Comply with NFPA 110, "Standard for Emergency and Standby Power Systems."
- E. Comply with NEMA ICS 1, "General Standards for Industrial Control," ICS 2, "Industrial Control Devices, Controllers and Assemblies," ICS 6, "Enclosures for Industrial Controls and Systems" and ICS10, "AC Automatic Transfer Switches."
- F. IEEE Standard 446, "Emergency and Standby Power," The Orange Book.

- G. UL Listing and Labeling: Items furnished under this section shall be listed and labeled by UL for emergency service under UL Standard 1008.
- H. Single-Source Responsibility: Obtain ATs, BP/Iss, remote annunciators and remote annunciator and control panels from a single manufacturer that assumes responsibility for all system components furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Automatic Switch Co.
 - 2. Caterpillar, Inc.
 - 3. Onan Corp.
 - 4. GE Zenith.
 - 5. Kohler.

2.2 TRANSFER SWITCH PRODUCTS, GENERAL

- A. Number of Poles and Current and Voltage Ratings: As indicated.
 - 1. Units smaller than 600 amperes shall not have different current ratings for different classes or mixtures of loads, including 100 percent tungsten filament lamp or 100 percent inductive load.
 - 2. Units 600 amperes and larger shall have current ratings that apply to mixtures of loads including 30-percent-maximum tungsten filament lamp load.
- B. Tested Fault-Current Withstand and Closing (WCR) Ratings: Withstand and closing ratings shall exceed the indicated available rms symmetrical fault current at the equipment terminals based on testing according to UL Standard 1008, conducted at full-rated system voltage and 20 percent power factor. Rate each product for withstand duration time as follows when tested for rated short-circuit current correlated with the actual type of circuit protective device indicated for transfer switches for this project. WCR shall be based on use of the same set of contacts for the withstand test and the closing test.
 - 1. Transfer switch(es) shall have a time duration Withstand and Closing Rating (WCR) of at least 0.05 seconds (3 cycles at 60 Hz).
 - 2. Short-time WCR shall be rated for a duration of 0.5 seconds (30 cycles at 60 Hz).
 - 3. Transfer switches(es) with Withstand Ratings only and without Closing Rating shall not be acceptable. This applies for Short-Time and Time Duration WCR Ratings.
- C. Annunciation and Control Interface Components: Devices at transfer switches for communicating with remote annunciators or annunciator/control panels shall have communications capability matched with the remote device.
- D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20°C to 60°C.

- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage surge withstand capability requirements when tested according to ANSI C37.90.1, IEEE Guide for Surge Withstand Capability (SWC) Tests. Components meet or exceed voltage impulse withstand test of NEMA ICS 1.
- F. Neutral Terminal: Where 2- or 3-pole switches are indicated, provide fully rated, solid, unswitched neutral terminal except as indicated.
- G. Four-Pole Switches: Where 4-pole switches are indicated, provide full-capacity neutral switching.
- H. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated shall be double the nominal rating of the switch.

2.3 CONSTRUCTION

- A. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in both positions.
- B. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms suitable for safe manual operation under load.
- C. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent interphase flashover. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
- D. Transfer switches designated on the drawings as 4-poles shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Equipment using add-on accessory overlapping contacts are not acceptable.
- E. Transfer switches which are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs, sized to carry 100% of the current designated on the switch rating.
- F. Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking. Controls on cabinet door shall be key-operated.
- G. Transfer switches shall be mounted in enclosures as designated on the drawings. Separate enclosures shall be the NEMA type specified. The cabinet shall provide required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

2.4 AUTOMATIC CONTROLS

- A. Transfer switches that are designated on the drawing as automatic shall be provided with a fully automatic control system, and provisions for manual operation as described in this section.
1. 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 472, NEMA ICS-109.21 and IEC 801-2, 3 and 4. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs.
 2. Solid-state under voltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out 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.
 3. Controls shall be provided with a solid-state over and under frequency sensor to monitor source(s). Pickup bandwidth shall be adjustable from a minimum of +/-4% to a maximum of +/- 20% of nominal frequency. Dropout shall be +/-5% of nominal wider than pickup frequency bandwidth. Adjustable time delay shall be from 0.1 to 15 sec. 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.
 4. Provide Phase Sequence Monitor and Balance module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.
 5. 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.
 6. 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.
 7. 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.
 8. Power for transfer operation shall be from the source to which the load is being transferred.
 9. 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, as follows:
 - a. Source 1 OK
 - b. Start Gen Set
 - c. Source 2 OK
 - d. Transfer Timing
 - e. Transfer Complete
 - f. Retransfer Timing

- g. Retransfer Complete
 - h. Timing for Stop
10. Transfer switches shall be equipped with a field adjustable controls to allow the operator to control the transfer switch operating time during switching in both directions. The controls shall control the time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The transfer switch operating speed control feature shall have an adjustable range of 0 to 7.5 seconds. Phase angle monitor is not an acceptable substitute for this feature.

2.5 FRONT PANEL DEVICES

- A. Provide devices mounted on cabinet front consisting of:
- 1. A key-operated selector switch to provide the following positions and functions:
 - a. Test - Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with or without load transfer.
 - b. Normal - Normal operating position.
 - c. Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.
 - 2. Transfer switch position and source available lamps.

2.6 ACCESSORY ITEMS

- A. Transfer switches shall be equipped with accessories as follows:
- 1. 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.
 - 2. Manual Selector Switch: Provide a manual/automatic retransfer selector switch to provide either automatic retransfer after the retransfer time delay, or a manual retransfer when selected by an operator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting of Switches: Level and anchor the unit to the wall, if wall mounted type. If floor mounted type, provide a 4" high housekeeping pad, rated for seismic conditions, level and anchor the unit to the pad.
- B. Identify components according to Division 26 Section "Basic Electrical Materials and Methods."
- C. Installation shall comply with applicable state and local codes as required by the Authority Having Jurisdiction (AHJ). Install equipment in accordance with manufacturer's instruction and instructions included in the listing and labeling of the UL listed products.
- D. Installation of equipment shall include furnishing and installing all interconnecting wiring between components of the on-site power system.

3.2 WIRING TO REMOTE COMPONENTS

- A. Match type and number of cables and conductors to control requirements of transfer switches used. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.3 CONNECTIONS

- A. Tighten factory-made connections, including connectors, terminals, bus joints, mountings and grounding. Tighten field-connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. When manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.4 ADJUSTMENTS

- A. Transfer switch units are shipped with time delay settings preset at factory. Field adjust these settings to correspond to field conditions.
- B. Coordinate time delay settings with Owner to correlate with other settings of emergency electrical system equipment, either new or existing.

3.5 GROUNDING

- A. Make equipment grounding connections for transfer switch units as indicated and as required by the NEC.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise field tests. Coordinate scheduling of tests with Owner's Representative at least three weeks prior to the tests.
- B. Preliminary Tests: Perform electrical tests as recommended by manufacturer and as follows:
 - 1. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester. Include external annunciator and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
 - 2. Check for electrical continuity of circuits and for short circuits.
- C. Field Tests: Give 7 days' advance notice of tests and perform tests in presence of Owner's representative.
- D. Coordinate tests with tests of generator plant and run them concurrently.
- E. Tests: As recommended by manufacturer and as follows:
 - 1. Contact Resistance Test: Measure resistance of power contacts for automatic transfer switches, non-automatic transfer switches and bypass/isolation switches. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.

2. Operational Tests: Demonstrate interlocking sequence and operational function for each switch at least 3 times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate low phase-to-ground voltage for each phase of normal source to automatic transfer switches.
 - c. Verify time-delay settings and pickup and dropout voltages.
 - F. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets specified requirements.
 - G. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and measured insulation and contact resistance and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- 3.7 ON-SITE ACCEPTANCE TEST
- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted in conjunction with representatives of the manufacturer. The Engineer shall be notified in advance and shall have the option to witness the tests.
 - B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one-step rated load pickup test in accordance with NFPA 110 for the generator set and ATS. Electrical contractor shall be responsible to provide fuel for the genset to complete all testing and refill the genset tank upon test completion.
 - C. Coordinate test times with owner's representative and maintain emergency system availability for the other buildings on site.

END OF SECTION 260620

SECTION 260625 - UNINTERRUPTIBLE POWER SYSTEM (UPS)**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SCOPE

- A. Provide, install and test under load a complete and operable Uninterruptible Power System (UPS), including all devices and equipment specified herein, as shown on the drawings or required for the service. Equipment shall be new, factory tested, and delivered ready for installation.
- B. This specification describes a continuous duty, three phase, on-line, solid state UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning and back-up power protection. The system shall consist of a maintenance bypass section, solid state inverter, rectifier, battery charger, a 100% rated for continuous duty static switch and battery plant synchronizing circuitry as described herein.

1.3 APPLICABLE STANDARDS

- A. The UPS shall meet the requirements of the following standards:
 - 1. UL listed under 1778 4th Edition, Standards for Uninterruptible Power Supply Equipment.
 - 2. FCC rules and regulation of Part 15, Subclass B, Class A
 - 3. IEEE 587 - 1980/ANSI C62.41 - 1980 Standards for Surge Withstand Ability, Categories A3 and B3.
 - 4. IEC 61000-3-4, 4-4, 4-2, 4-3, 4-6, 2-2.
 - 5. National Electrical Code (NEC), NFPA 70
 - 6. National Electrical Manufacturer's Association (NEMA) PE-1
 - 7. Occupational Safety and Health Administration (OSHA)

1.4 SUBMITTALS

- A. System configuration with single-line diagrams
- B. Functional relationship of equipment including weights, dimensions and heat dissipation
- C. Descriptions of equipment to be furnished, including deviations from these specifications
- D. Size and weight of shipping units to be handled by installing contractor
- E. Detailed layouts of customer power and control connections
- F. Detailed installation drawings including all terminal locations. Interconnect wiring diagrams showing conduit wiring with terminal numbers for each wire.

- G. Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals that shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.5 WARRANTY

- A. The UPS shall be covered by a full parts and labor warranty from the UPS manufacturer. The warranty period shall be for 18 months from date of shipment or 12 months after initial startup, whichever comes first.
- B. The battery manufacturer's standard warranty shall be passed through to the end user.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. UPS shall be Liebert Model number eXM with Bypass Distribution Cabinet and Battery Cabinet or equivalent APC or Eaton.

2.2 SYSTEM DESCRIPTION

A. UPS Module

1. Rectifier Input Voltage: 480/277 volts, three-phase, 4-wire-plus-ground
2. Bypass Input Voltage: 480/277 volts, three-phase, 4-wire-plus-ground
3. Output Voltage: 480/277 volts, three-phase, 4-wire-plus-ground
4. Output Load Capacity of the UPS shall be unity power factor as indicated on plans.
5. Current Sharing: When multiple UPS modules are connected in parallel and powering a common load, each UPS module output current will not differ by more than 5% of the rated full load current of one UPS module.

B. Battery

1. Battery Cells: Valve-regulated, lead acid batteries.
2. Reserve Time: 8 minutes at rated load and unity power factor, with ambient temperature of 77°F (25°C). Unit shall provide terminal for connection of external batteries.
3. Recharge Time: to 95% capacity within ten (10) times discharge time.

C. Modes of Operation

1. The UPS shall be designed to operate as an on-line, reverse-transfer system with the following operating modes:
 - a. Normal - The critical AC load is continuously supplied by the UPS inverter. The rectifier/charger derives power from an AC source and supplies DC power to the inverter while simultaneously float-charging the reserve battery.
 - b. ECO Mode - The critical AC load shall be continuously powered by the bypass with the inverter available to power the load if the bypass source voltage or frequency exceeds adjustable parameters of power quality.

- c. Battery - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
- d. Recharge - Upon restoration of utility AC power after a utility AC power outage, the rectifier/charger shall automatically restart, gradually ramp up output voltage and assume the inverter and battery recharge loads.
- e. Bypass - If the UPS must be taken out of service for maintenance or repair or if the inverter overload capacity is exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.
- f. Off-Battery - If the battery only is taken out of service, it shall be disconnected from the DC Converter by the external disconnect circuit breaker. The UPS shall continue to function and meet all the specified steady-state performance criteria, except for the power outage back-up time capability.

D. Performance Requirements

1. AC Input to UPS

- a. Voltage Configuration for Standard Units: 480/277, three-phase, four-wire plus ground
 - b. Voltage Range: -15%, +20% of nominal without derating at full load.
 - c. Frequency: 40-70Hz
 - d. Power Factor: 0.99 full load, 0.98 half load
 - e. Inrush Current: UPS inrush current not to exceed 1.5 times rated input current. Maintenance bypass and distribution cabinet inrush current not to exceed 8 times rated input current.
 - f. Current Limit: 140% of nominal AC input current maximum
 - g. Current Distortion: <5% reflected THD maximum at full load
 - h. Surge Protection: Sustains input surges without damage per criteria listed in EN 61000-4-5:1995.
- 1) Short Circuit Current Rating: 65kA certified on applied label.

2. AC Output, UPS Inverter

- a. Voltage Configuration: three-phase, 4-wire plus ground
- b. Voltage Regulation: $\pm 1\%$ three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature and load power factor, $\pm 2\%$ three-phase RMS average for a 100% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature and load power factor.
- c. Frequency: $\pm 2\%$
- d. Frequency Slew Rate: Selectable from 0.1Hz/sec to 3.0Hz/sec maximum for single unit.
- e. Phase Balance: 120 degrees ± 1 degree for balanced load, 120 degrees ± 2 degrees for 100% unbalanced load.

- f. Voltage Distortion: <1% total harmonic distortion (THD) for linear loads <5% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating
- g. Load Power Factor Range: 0.7 lagging to 0.9 leading without derating
- h. Output Power Rating: 0.99 full load. 0.98 half load
- i. Overload Capability: 110% for 60 minutes, 125% for 10 minutes, 150% for 60 seconds
- j. Voltage Transient Response: 100% load step, $\pm 5.0\%$
- k. Transient Recovery Time: to within 5% of steady state output voltage within half a cycle
- l. Voltage Unbalance: 100% unbalanced load, $\pm 5\%$

E. Environmental Conditions

- 1. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:
 - a. Operating Ambient Temperature
UPS Module: 32°F to 104°F (0°C to 40°C)
Battery: 77°F $\pm 5^\circ\text{F}$ (25°C $\pm 3^\circ\text{C}$)
 - b. Storage/Transport Ambient Temperature
UPS Module: -4°F to 158°F (-20°C to 70°C)
Battery: -4°F to 86°F (-20°C to 30°C)
 - c. Relative Humidity 0 to 95%, non-condensing
 - d. Altitude
Operating: 3300 ft. (1000m) above sea level. Storage/Transport: to 50,000 ft. (12,200m) above mean sea level.
 - e. Audible Noise 59dBA at 4.6 feet from unit.

2.3 MATERIALS

- A. All materials of the UPS shall be new, of current manufacture and high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All power semi-conductors shall be sealed. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All electronic components shall be accessible from the front without removing sub-assemblies for service access.
- B. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA and applicable local codes and standards. All bolted connections of busbars, lugs and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections shall be torqued to the required value and marked with a visual indicator. Provisions shall be made in the cabinets to permit installation of input, output and external control cabling, using raceway or conduit. Provision shall be made for top and bottom access to input, output, bypass and DC connections. In conformance with NEC, connection cabinets shall provide for

adequate wire bend radius. All copper busbars for customer power connections shall be tin plated for connection integrity.

- C. The UPS shall be in NEMA Type 1 enclosures, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking and forklift handling. Maximum cabinet height shall be 78.7 in. (2000mm).
- D. Cooling
 - 1. Cooling of the UPS shall be by forced air using a redundant fan configuration. Fan power shall be provided by the UPS. The UPS requires 6 inches (152mm) rear clearance and 24 inches (610mm) top clearance for air flow.
 - 2. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded. Air filters shall be located at the point of air inlet and be changeable.
 - 3. Access shall be:
 - a. UPS: Front access, 36" minimum.
 - b. Maintenance bypass cabinet: Front access only, 36" minimum.
 - c. Battery cabinet: Front and top access only for service.
- E. Rectifier/Charger
 - 1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert AC to regulated DC for input to the inverter and for charging the battery.
 - 2. The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 140% of the full input current rating.
 - 3. The rectifier/charger shall have an output filter to minimize ripple current into the battery. The AC ripple voltage of the rectifier DC output shall not exceed 1% RMS of the float voltage. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter without the battery connected.
 - 4. Upon restoration of utility AC power, after a utility AC power outage and prior to a UPS automatic end-of-discharge shutdown, the rectifier/charger shall automatically restart, walk-in and gradually assume the inverter and battery recharge loads.
 - 5. In addition to supplying power for the inverter load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.
 - 6. There shall be DC overvoltage protection so that if the DC voltage rises to the preset limit, the UPS will shut down automatically and initiate an uninterrupted load transfer to the static bypass line.

F. Inverter

1. The term inverter shall denote the equipment and controls to convert DC from the rectifier/charger or battery to precise AC to power the load. The inverter shall be solid-state, capable of providing rated output power, and for increased performance the inverter shall be a pulse-width-modulated design and utilize insulated gate bipolar transistors (IGBTs).
2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 60 seconds, 125% of full load for 10 minutes and 110% of full load for 60 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.
3. The inverter shall be capable of supplying an overload current of 150% of its full-load rating for one minute. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The critical load will be transferred to the static bypass automatically and uninterrupted. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.
4. Voltage Distortion
 - a. Total harmonic distortion in the output voltage will not exceed 1% for 0% to 100% linear loads.
 - b. Total harmonic distortion in the output voltage will not exceed 4% for 0% to 100% non-linear loads.
 - c. Total harmonic distortion in the output voltage will not exceed 5% for 0% to 100% non-linear, unbalanced loads.
5. Electronic controls shall be provided to regulate each phase so that an unbalanced loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement. With 100% load on one phase (and 0% load on the other two phases) or 100% load on two phases (and 0% load on the other phase), the voltage balance is to be within 5% and the phase displacement is to be 120 degrees within a range of ± 1.5 degrees.
6. For rapid removal of the inverter from the critical load, the inverter control electronics shall instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned on to maintain continuous power to the critical load.
7. The inverter shall be protected by the following disconnect levels:
 - a. DC Overvoltage Shutdown
 - b. DC Undervoltage Warning (Low Battery Reserve)-pre-warning time is adjustable
 - c. DC Undervoltage Shutdown (End of Discharge)
8. The output frequency of the inverter shall be controlled by a high-speed DSP capable of holding the inverter output frequency to within $\pm 0.1\%$ for a single module or $\pm 0.25\%$ for

six modules during steady state and transient conditions. Total deviation from the rated frequency, including short time fluctuations and drift, shall not exceed 0.1% for a single module or 0.25% for six modules.

G. Display and Controls

1. The UPS shall be provided with a microprocessor-based control panel designed for convenient and reliable user operation. A back lit, menus driven, full graphics, color touchscreen display (LCD) shall be used to show a single-line diagram of the UPS and shall be provided as part of the monitoring and controls sections of the UPS. All operator controls and monitors shall be located on the front of the UPS cabinet. Monitoring functions such as metering, status and alarms shall be displayed on the touchscreen LCD. Additional features of the monitoring system shall include:
 - a. Menu-driven display with touchscreen navigation
 - b. Real-time clock (time and date)
 - c. Alarm history with time and date stamp
 - d. Memory with battery backup
2. Metering
 - a. Input AC voltage line-to-line
 - b. Input AC current for each phase
 - c. Input frequency
 - d. Battery voltage
 - e. Battery charge/discharge current
 - f. Output AC voltage line-to-line
 - g. Output AC current for each phase
 - h. Output frequency
 - i. Apparent power
 - j. Real power
 - k. Battery time left during battery operation
 - l. Battery temperature
3. Alarm Messages
 - a. Mains Voltage Abnormal
 - b. Mains Undervoltage
 - c. Mains Freq. Abnormal
 - d. Charger Fault
 - e. Battery Reversed
 - f. No Battery
 - g. Control Power 1 Fail
 - h. Parallel Comm. Fail
 - i. Bypass Unable To Track
 - j. Bypass Abnormal
 - k. Inverter Asynchronous
 - l. Fan Fault
 - m. Control Power 2 Fail

- n. Unit Over Load
 - o. System Over Load
 - p. Bypass Phase Reversed
 - q. Transfer Time-Out
 - r. Load Sharing Fault
 - s. Bypass Over Current
 - t. Output Ground Fault
4. Status Messages
- a. Rectifier (Off / Soft Start / Main Input On / Battery Input On)
 - b. Input Supply (Normal Mode / Battery Mode / All Off)
 - c. Battery Self Test (True / False)
 - d. Input Disconnect (Open / Closed)
 - e. EPO (True / False)
 - f. Charger (On / Off)
 - g. Output Disconnect (Open / Closed)
 - h. Maint. Disconnect (Open / Closed)
 - i. Bypass Disconnect (Open / Closed)
 - j. Inverter (Off / Soft Start / On)
 - k. Bypass (Normal / Unable To Trace / Abnormal)
 - l. Output Supply (All Off / Bypass Mode / Inverter Mode / Output Disable)
 - m. Inverter On (Enable / Disable)
5. UPS startup, shutdown and static bypass operations shall be accomplished through the touchscreen on the front panel. Menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. The touchscreen shall display the status of the UPS and to test and reset visual and audible alarms. A mimic screen shall be available on the LCD to depict a single-line diagram of the UPS with switch positions and power flow.
6. On-Line Battery Test: The UPS shall be provided with a menu-driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode.

H. Static Transfer Switch

1. A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating to clear a 20-ampere load branch circuit breaker. The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS or to bypass the UPS for maintenance.

2. The transfer control logic shall automatically turn on the static transfer switch, ensuring uninterrupted transfer of the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:
 - a. Inverter overload capacity exceeded
 - b. Critical AC load overvoltage or undervoltage
 - c. UPS fault condition
 3. The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:
 - a. Bypass frequency out of limits
 - b. Bypass out-of-synchronization range with inverter output
 4. Retransfer of the critical AC load from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:
 - a. Bypass out of synchronization range with inverter output
 - b. Inverter/bypass voltage difference exceeding preset limits
 - c. Overload condition exists in excess of inverter full load rating
 - d. UPS fault condition present
- I. Battery Power Pack
1. The battery power pack shall include valve-regulated, lead-acid battery cells housed in a separate cabinet that matches the UPS cabinet styling to form an integral system lineup. Battery cells shall be mounted on slide-out trays for ease of maintenance. A battery disconnect circuit breaker shall be included for isolation of the battery pack from the UPS module. Casters and leveling feet shall also be provided with the battery power pack cabinet for ease of installation. When the application calls for the battery cabinet to be bolted to the UPS cabinet, an interconnecting cable kit shall be provided, precut and pre-lugged.
- J. Web Communications Card
1. Provides communication outputs to indicate a change of status of the UPS. Outputs are provided for:
 - a. SNMP
 - b. HTML - Web page
 - c. Allow use of network management systems
 2. Provide a make-before-break maintenance bypass with Solenoid Key Release Unit (SKRU) interlock in a cabinet that matches and may be bolted up to the right side of the UPS. Installation of the cabinet shall not affect the cooling ability of the UPS. Thermal-magnetic breakers shall be provided for bypass and maintenance isolation.
- K. Emergency Power Off Kit (EPO)

1. The EPO Kit facilitates the remote placement of a push-button assembly that will shutdown the UPS System in the event of an emergency.
2. Provide push-button stations at the exit door from the Server Room and one at the UPS.

2.4 FACTORY TESTING

- A. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.
- B. Submit a written report of those tests.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment and components per manufacturer's written instructions.
- B. Identify components per Division 26 Section "Basic Electrical Materials and Methods."
- C. Provide all required conductors, cables, terminations, supports and appurtenances as required for a complete and operable system.
- D. Install UPS on the floor.
- E. Tighten all connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. When manufacturer's values are not indicated, comply with torques specified in UL Standards 486A and B.

3.2 FIELD QUALITY CONTROL

- A. The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup. Submit a written report detailing the results of each test.
 1. Visual Inspection
 - a. Inspect equipment for signs of damage.
 - b. Verify installation per drawings.
 - c. Inspect cabinets for foreign objects.
 - d. Verify neutral and ground conductors are properly sized and configured.
 - e. Inspect battery cases.
 - f. Inspect battery for proper polarity.
 - g. Verify all printed circuit boards are configured properly.
 2. Mechanical Inspection
 - a. Check all control wiring connections for tightness.
 - b. Check all power wiring connections for tightness.
 - c. Check all terminal screws, nuts and/or spade lugs for tightness.
 3. Electrical Inspection

- a. Check all fuses for continuity.
 - b. Confirm input voltage and phase rotation is correct.
 - c. Assure connection and voltage of the battery string(s).
- B. The UPS manufacturer shall directly employ a nationwide service organization consisting of factory-trained field service personnel dedicated to the startup and maintenance of UPS and power equipment. The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, 365 days/year. If emergency service is required, on-site response time shall be four hours or less and within 150 miles of the manufacturer's authorized services center.
- C. Parts shall be available through an extensive network to ensure round-the-clock parts availability throughout the country. Spare parts shall be stocked by local field service personnel with backup available from national parts center and the manufacturing location. A national parts center Customer Support Parts Coordinator shall be on call 24 hours a day, 7 days a week, 365 days a year for immediate parts availability.
- D. A complete offering of preventive and full-service maintenance contracts for both the UPS system and battery system shall be available.
- E. The UPS manufacturer shall provide as an option an automated site-monitoring service. This service shall be staffed by a qualified support person 24 hours/day, 7 days/week, 365 days/year. At the detection of an alarm within the UPS, the controls shall initiate communications with the monitoring service. The monitoring service shall be capable of interpreting the communicated alarms to allow dispatch of a service engineer.

END OF SECTION 260625

SECTION 260721 – FIRE ALARM SYSTEMS - ADDRESSABLE**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes addressable fire alarm systems.
- B. This section is intended to outline design build performance specifications for the complete fire alarm system.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260000 Basic Electrical Requirements
- C. Section 260010 Basic Electrical Materials and Methods
- D. Section 260025 Seismic Restraints

1.3 QUALITY ASSURANCE

- A. The equipment and installation shall comply with the current applicable provisions of the following standards:
 - 1. National Electrical Code, NFPA 70
 - 2. National Fire Alarm Code, NFPA 72
 - 3. International Building Code, IBC
 - 4. Life Safety Code, NFPA 101
 - 5. UL 864, 9th Edition Listed and Factory Mutual Approved
 - 6. ADA and ANSI A117.1
 - 7. NECA 305, "Standard for Fire Alarm System Job Practices"
 - 8. Applicable Local and State Building codes
 - 9. Requirements of the Local Authority Having Jurisdiction.
- B. Equipment Supplier Qualifications
 - 1. The fire alarm equipment supplier shall have a NICET level 4 certified individual on staff responsible for overseeing the technical design and engineering functions related to the fire alarm system. The current NICET level 4 certificate number must be submitted to the engineer with shop drawings submittals.
 - 2. The fire alarm equipment supplier shall have on staff NICET level 2 technicians supervising the final connections and programming of the system.
 - 3. The equipment supplier must be an authorized distributor/dealer of the equipment being provided. The supplier must be factory authorized to service under warranty the components furnished. Two stepping of equipment from a "box house" or out of area distributor is not allowed.

4. Fire Alarm Contractor shall be capable of providing signed and sealed shop drawings for the fire alarm system, by a Professional Engineer of the State in which the project is located.

1.4 SUBMITTALS

A. Fire Alarm Documents

1. The Contractor shall provide fully engineered and signed and sealed fire alarm documents, including final device and appliance layout and coverage, equipment details and cutsheets, battery calculations, voltage drop calculations, wiring details and diagrams, and as otherwise required or requested by the AHJ. Drawings shall be signed and sealed by a Professional Engineer of the State in which the project is located. No fire alarm documents will be signed and sealed by SSC Engineering. The drawings and specifications provided in the Contract Documents are intended to outline design build performance specifications and the owner's minimum requirements for the fire alarm system. The Contractor shall provide the complete final design. If any deficiencies or conflicts exist in the Contract Documents, the Contractor shall immediately notify the Engineer prior to submitting a bid.

B. Shop Drawings

1. The Contractor shall provide complete fire alarm system documents signed and sealed documents by a Professional Engineer of the State in which the project is located as follows:
 - a. Battery calculations
 - b. Voltage drop calculations
 - c. Wiring details and diagrams including types and sizes
 - d. Location of FACP, power supplies, DACT, annunciators, power connections, etc.
 - e. Floor plan indicating use of each room, ceiling heights and construction
 - f. Fire alarm matrix and interface of the fire safety controls functions
 - g. Equipment, device and material cutsheets and technical details including but not limited to the model number, listing info, type, rating, size, style, for all items.
 - h. Complete list of deviations, exceptions and variations from the Contract Documents related to the fire alarm system and associated equipment and systems.
2. The fire alarm shop drawings will be returned incomplete if signed and sealed documents as outlined above are not submitted. Engineer will provide a preliminary shop drawing review for general conformance prior to submitting final signed and sealed drawings upon request.
3. In the event a separate fire alarm permit/review is required, the signed and sealed Contractor shop drawings are to be submitted to SSC Engineering for review prior to SSC Engineering providing any signed and sealed fire alarm Contract Documents.
4. It is the responsibility of the Contractor to provide the above information in a timely fashion to accommodate the construction schedule.

5. Provide proof of authorization from equipment manufacturer for being a dealer and NICET certificates. The current NICET level 4 certificate number must be submitted to the engineer with shop drawings submittals. Shop drawing will be rejected if a current NICET certificate is not submitted.
 6. Provide proof of authorization from equipment manufacturer for being a true authorized distributor/dealer for service and warranty as well as NICET certificates.
- C. Record Drawings
1. Provide one complete set of as-built record drawings following project completion. The drawings shall include:
 - a. Routing of conduit and all wiring from each device, i.e. smoke detector, signaling appliance, etc. to the control panel, or remote power supply.
 - b. Clearly identify each indicating appliance circuit, initiating or SLC circuit, control circuit, etc. and quantity of conductors.
 - c. Device location and identification number, control panel, circuit breaker and end-of-line resistor locations.
 2. Provide one complete set of Operations and Maintenance Manuals, including completed Initial Acceptance Test form, Record of Completion form, and final submittal documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The FACP shall be a Notifier N16e or approved equal and shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, annunciators and other system controlled devices. The panel shall be UL listed as a Fire Alarm Control Panel per UL 864, 10th Edition.
- B. Equal systems by Simplex, Siemens, Potter, or Gamewell-FCI shall be considered approved equals provided the systems meet all performance requirements of these specifications.

2.2 SYSTEM GENERAL OPERATION

- A. System Alarm Detection
 1. When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
 - a. The System Alarm LED shall flash.
 - b. A local signal in the control panel shall sound.
 - c. The 80-character LCD display shall indicate all information associated with the Fire Alarm condition, including: type of alarm point, its location within the protected premises and the time and date of that activation.
 - d. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed including:

- 1) Alarm Indicating appliances.
 - 2) Control relays for general air handler shutdown.
 - 3) Control relays to recall and shut down power to the elevators per ASME A17.1 requirements.
 - 4) Central station outputs for connection digital communicator:
 - a) Alarm
 - b) Trouble
 - c) Supervisory
 2. The Microprocessor unit shall contain and execute all control by event programs for specific action to be taken if an alarm condition is detected by the system. Such control by event programs shall be held in nonvolatile programmable memory and shall not be lost even if system primary and secondary power failure occurs.
 3. All programming of the system may be achieved without special equipment or lap top computers and without interrupting the alarm monitoring functions of the Fire Alarm Control Panel. If special hardware or software is required to program the system it must be included in this contract and be provided to the owner at time of delivery and the owner must be trained on the programming of the system.
 4. Program edit shall not interfere with normal operation and fire protection. If a fire condition is detected during programming operation, the system shall exit programming and perform fire protection functions as programmed.
 5. Provide a battery back-up and charging system for 24 hours of standby and 5 minutes of alarm for the entire fire alarm system.
 6. Provide batteries sized as required per the battery calculations and include a remote battery cabinet if required. Provide seismic rated battery hold down kit and mounting kit.
- B. Special FACP Features
1. The FACP shall provide the following features:
 - a. Drift Compensation to extend detector accuracy over life.
 - b. Sensitivity Test, meeting requirements of NFPA 72.
 - c. Maintenance Alert to warn of excessive compensation.
 - d. System Status Reports to display or printer.
 - e. Alarm Verification, with verification counters.
 - f. Non-Alarm points for general (non-fire) control.
 - g. Periodic Detector Test, conducted automatically by software.
 - h. Walk Test, with check for two detectors set to same address.
 - i. Control by Time for non-fire operations, with holidays.
 - j. Day/Night automatic adjustment of detector sensitivity.
- C. Control Panel Switches
1. Acknowledge Switch

- a. Activation of the control panel Acknowledge switch in response to new Alarms and/or Troubles shall silence the local panel piezo electric signal and change the Alarm and Trouble LEDs from flashing mode to steady ON mode. If multiple Alarm or Trouble conditions exist, depression of this switch shall advance the 80 character LCD display to the next Alarm or Trouble condition. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
2. Signal Silence Switch
 - a. Activation of the Signal Silence Switch shall cause all programmed Alarm Indicating Appliances and relays to return to the normal condition after an alarm condition. The selection of indicating circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
3. System Reset Switch
 - a. Activation of the System Reset Switch shall cause all electronically latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition. Holding the RESET switch shall perform a Lamp Test function.
4. Drill (Evacuate) Switch
 - a. Press and hold of the Drill switch shall activate all Indicating Appliance circuits. The Drill function shall latch until press of Signal Silence or Reset.
- D. SLC Loop Interface
 1. The SLC Interface shall provide power to, and communicate with, all of the Intelligent/Addressable Detectors and Addressable Modules over a single pair of wires.
 2. The Loop Interface Board shall receive analog information from all Intelligent Detectors that shall be processed to determine whether normal, alarm or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
 3. The detector software shall meet NFPA 72 requirements and be certified by UL as a calibrated sensitivity test instrument.
 4. Provide dedicated loops as required to accommodate design requirements.
- E. System History Recording and Reporting
 1. The Fire Alarm Control Panel shall contain a History Buffer that will be capable of storing up to 400 system alarms/troubles/operator actions. Each of these activation's will be

stored and time and date stamped with the actual time of the activation. The contents of the History Buffer may be manually reviewed, one event at a time.

2. The History Buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.
- F. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel which shall include a backlit 80 character Liquid Crystal Display, individual, color coded system status LEDs and an alpha-numeric keypad for the Field Programming and Control of the Fire Alarm System.
- G. The remote fire alarm annunciator shall include a full featured operator interface control and annunciator panel which shall include a backlit 80-character liquid crystal display; individual color coded system status LEDs and an alpha-numeric keypad for the field programming and control of the fire alarm system. Notifier model N-ANN-80.
- H. Maintenance Functions
1. Smoke Detector Sensitivity Adjust
 - a. Means shall be provided for adjusting the sensitivity of any or all analog intelligent detectors in the system from the System keypad. Sensitivity range will be within the allowed UL window and shall be HIGH/MEDIUM/LOW selection.
 2. Alarm Verification
 - a. Each of the Intelligent/Addressable Smoke Detectors in the system shall be alarm verified. The Alarm Verification Function shall be from 5-50 seconds and each detector shall be able to be enabled/disabled during the field programming of the system, or any time after system turn-on.
 3. Automatic Detector Maintenance Alert
 - a. The Fire Alarm Control Panel shall automatically interrogate each Intelligent Smoke Detector and shall analyze the detector responses over a period of time. If any Intelligent Smoke Detector in the system responds with a reading that is below or above normal limits, then the system will enter the Trouble Mode and the particular Detector will be annunciated on the System Display. This feature shall in no way inhibit the receipt of Alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
- 2.3 FIELD DEVICES
- A. Addressable Manual Stations
1. Addressable Manual Stations shall be provided to connect one addressable, supervised Manual Station to one of the Fire Alarm Control Panel Signaling Line Circuit (SLC) Loops. The Manual Station shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. Manual Fire Alarm Stations shall be crush tube type with a key operated test-reset lock. Notifier model NBG-12LX with SB-I/O as required.

B. Automatic Fire Detectors**1. Analog Addressable Photoelectric Type Smoke Detectors**

- a. The Photoelectric-Type Smoke Detectors shall be Intelligent and Addressable and shall connect with two wires to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. The detectors shall use the light obscuration principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.
- b. The detectors shall be ceiling-mount and shall include a twist-lock base. The detectors shall provide address-setting means on the detector head using rotary decimal switch and shall also store an internal identifying code which the control panel shall use to identify the type of detector. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector sensitivity shall be set through the Fire Alarm Control Panel and shall be adjustable in the field through the field programming of the system. Notifier model FSP-951 with B300-6 standard base.

2. Analog Addressable Duct Smoke Detectors

- a. Duct Smoke Detectors shall be addressable and analog photoelectric type devices enclosed in a duct type housing and supplied with sampling tubes sized for the duct. The detectors shall be Intelligent and Addressable and shall connect with two wires to the Fire Alarm Control Panel Signaling Line Circuit. The detector sensitivity shall be set through the Fire Alarm Control Panel and shall be adjustable in the field through the field programming of the system. Notifier model DNR with FSP-951, DST-XX sampling tubes, and RTS151KEY remote test switch station with key lock.

3. Analog Addressable Heat Detectors

- a. The Intelligent Heat Detectors shall be Intelligent and Addressable and shall connect with two wires to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. The detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.
- b. The detectors shall be ceiling-mount and shall include a twist-lock base. The detectors shall provide address-setting means on the detector head using rotary decimal switch and shall also store an internal identifying code, which the control panel shall use to identify the type of detector. Notifier FST-951, 135 degree fixed thermal detector or FST-951H, 190 degree fixed thermal detector with B300-6 standard base.

C. Remote Fire Alarm Annunciator Panel (FAAP):

1. The remote fire alarm annunciator shall include a full featured operator interface control and annunciator panel which shall include a backlit 80-character liquid crystal

display; individual color coded system status LEDs and an alpha-numeric keypad for the field programming and control of the fire alarm system. Notifier model RLD.

D. Control Module

1. Control Modules shall be provided to supervise and control the operation of one signal circuit or as an addressable Dry Contact (Form C) Relay for elevator and air handler control. The Control Module shall provide address-setting means using rotary decimal switches and shall also store an internal identifying code which the Control Panel shall use to identify the type of device. Notifier model FCM-1 or FRM-1

E. Monitor Module

1. Monitor modules shall be provided to connect any N.O. dry contact device (water flow, tamper switches and kitchen hood) to the Fire Alarm Control Panel Signaling Line Circuit Loop. The Monitor module shall provide address-setting means using rotary decimal switches and shall also store an internal identifying code which the Fire Alarm Control Panel shall use to identify the type of device. Notifier model FMM-1, FMM-101 or FDM-1 (Dual).

F. Horn Strobes

1. Audible signals shall be all-electronic and shall not require vibrating solenoids or contacts. They shall be 24 VDC polarized and meet UL 1971. Mounting shall be semi-flush using standard back boxes. The visual section shall be 24 VDC polarized Xenon strobe with FIRE lettering clearly visible. The horn shall include a high/low switch to provide 100 dBA (high) or 94 dBA (low) sound pressure based on anechoic chamber measurements. Set on low volume setting in small rooms, stairwells and restrooms. The horn output shall be switch selectable between a continuous tone or Temporal Code 3 tone. Set tone to Temporal Code 3 pattern. Provide signals based on the following types (verify white housing is acceptable with AHJs prior to ordering.):
 - a. Horn/ strobe with multi-candela output: Gentex GEC3-24WW for wall mounted. GCC24CW for ceiling mounted.
 - b. Strobe light with multi-candela output: Gentex GES3-24WW for wall mounted. GCS24CW for ceiling mounted.
2. Provide weatherproof appliance and back box when installed exterior to the building, within wet locations or wherever located outside the listed environment of the "standard" notification appliance.

G. Magnetic Door Holders

1. Magnetic door holders shall be 120 VAC and 24 VAC/DC models with 35 to 40 pounds holding power. Magnet protected against transients and surges up to 600 volts (AC models). Magnetic field intensity of 5.6 oersteds and 1 meter. Fail-safe operation; power failure releases door to close. Floor and wall models and two year warranty. Holder shall be Notifier FM980 for floor mounting or FM998 for flush wall mounting or equivalent by Sentrol.

H. Remote Power Supplies

1. Signaling appliance remote power supplies shall be UL listed for fire alarm signaling and provide 6 amps of 24 VDC power. The power supply shall include 4 style Y notification appliance circuits. Provide two (2) 7.0 amp hour batteries with each power supply. Remote power supply shall be Notifier model PSE-6 or Potter PSN-106B. Provide as required for audible/visual signals.
2. Provide with seismic restraint of batteries, model SEISKIT-MULTI-1 or equivalent.

I. Surge Protection Devices

1. Where metallic fire alarm cabling leaves the building above or below grade to an exterior device, provide surge protection where the cabling exits the building. Where devices are mounted to an exterior wall and cabling does not extend past the building façade, surge protection may be omitted. Surge device shall be equivalent to Ditek.

J. Central Monitoring Equipment shall be UL listed and include a commercial fire digital communicator complete with the following features:

1. Meet NFPA 72 requirements for Digital Alarm Communicator Transmitter.
2. Capable of seizing the proper communication method at the protected premises, disconnecting an outgoing or incoming call and preventing its use until signal transmission has been completed.
3. Contain a minimum of 4 channels.
4. Connected to two separate communication methods at protected premises.
5. Capable of selecting the operable communication method in the event of a failure on either method.
6. Programmed to utilize the alternate method should the signal transmission be unsuccessful.
7. Equipped with battery pack, charger, telephone jack and dedicated 120 VAC receptacle.
8. The digital communicator shall be connected to the fire alarm system to receive and transmit alarm signals, trouble conditions and supervisory conditions. Digital Communicator shall be Notifier model 411UDAC. Monitoring service and communicator programming shall be furnished by owners monitoring company.
9. Provide a dual path communicator module/device that utilizes IP communication and cellular (GSM or CDMA) communication. Provide programming, cables and connectors as required. Owner to provide active data port.

PART 3 - EXECUTION**3.1 POWER SOURCE**

- A. The Fire Alarm Control Panel shall be connected to a separate dedicated 120 volt, 20 Amp branch circuit. This circuit shall be labeled at the Electrical Panel as FIRE ALARM.
- B. The fire alarm remote power supplies shall be connected to a dedicated 120 volt, 20 amp branch circuit labeled as FIRE ALARM. Provide required quantities of power supplies and circuits as required.

3.2 WIRING

- A. Wiring will be as required by the Equipment Supplier. Wire color coding and the color shall remain the same throughout the system. In general, all initiating devices such as manual stations, thermal detectors and smoke detectors shall be installed across a common #18 AWG twisted shielded pair. The signal circuits shall require #14 AWG. All system wiring shall be plenum rated wire. The ground will be minimum one #6 AWG insulated copper. Provide conduit with insulated bushing in wall from device up to accessible ceiling.
- B. Provide surge protection devices on all circuits that enter the building from the exterior. Surge suppression shall be equivalent to Ditek.

3.3 TESTING

- A. The operation of the Fire Alarm System shall be checked by a representative of the equipment supplier. At the final inspection, a factory-trained representative of the manufacturer of the equipment shall demonstrate that the system functions properly in every respect. A report describing the test results shall be submitted to the Engineer.
- B. The system will not be accepted until final testing and receipt of the NFPA 72 Inspection and Testing Form has been obtained and approved.
- C. System shall be tested and installed to maintain the UL "UUFX" listing as required by the AHJ, Fire Protection District or Fire Department.

3.4 INSTRUCTION

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system including changes and functions shall be provided.
- B. The contractor and/or the systems manufacture's representatives shall provide a type written "sequence of operation" to allow the owner to silence reset and acknowledge the fire alarm control panel.
- C. Provide a minimum of eight (8) hours training for staff personnel in the operation and maintenance of the system.

3.5 INSTALLATION

- A. In order to assure compliance with the NFPA Standards and manufacturers requirements the fire alarm equipment supplier to the electrical contractor must perform the following functions:
 - 1. Install and connect each and every detector, signaling appliance, pull station, control/monitor module, annunciator etc., excluding the rough-in and cabling between the devices.
 - 2. The electrical contractor shall install rough-in and cable between rough-in points as required by the fire alarm system supplier. Rough-in includes control panel back boxes, remote power supply back boxes and digital communicator back boxes.

3. The electrical contractor shall provide any conduit, all required back boxes, 120 volt power and connections of the 120 volt power as required by the fire alarm equipment supplier to meet the functionality specified herein.
4. Subcontracting by the fire alarm equipment provider to perform the field device installation and connections is not acceptable.
5. Open conductors and conduits shall be supported in a manner and at intervals compliant with NEC requirements. Conductors and conduits installed above lay-in ceilings shall be supported from the building structure and shall not be permitted less than 9-inches above or behind removable panels or ceiling tiles.
6. All wires shall be tagged at all junction points and shall test free from grounds or crosses between conductors.
7. No other conductors shall be installed in conduits with conductors for the fire alarm system.
8. Smoke detectors shall be protected from construction dust until after the construction clean-up of all trades is complete and final. Detectors that have not been protected prior to final clean-up by all trades shall be cleaned or replaced.
9. A UL Certificate or FM Placard, per NFPA 72, shall be issued by the UL Listed or FM Approved contractor for all newly installed, required fire alarm systems.

B. Equipment Mounting

1. The control panel shall be flush mounted with no operational parts which may require maintenance mounted greater than 72-inches above the finished floor. The control panel annunciator shall be mounted so that no switch, manually operated device, display or LED is greater than 60-inches above the finished floor.
2. Duct detectors shall be provided under this section and will be mounted by the HVAC contractor at the supply side of all HVAC units of 2,000 cfm or greater and at the return side of all HVAC units of 2,000 cfm or greater per NFPA 90A and IMC, or as shown on the drawings. Supervise and coordinate placement by HVAC contractor and connect all circuits. Duct detectors shall be mounted in such a way as to obtain a representative sample of the airstream. The duct detectors shall be located in the zone between 6 and 10 duct widths from any duct bends or inlets. When located at duct openings, use spot detectors mounted as required by NFPA 72 for duct openings. Detectors shall be accessible for cleaning and shall be mounted in accordance with the manufacturer's instructions and NFPA standards.
3. At each smoke or fire smoke damper provide a spot detector pendant mounted in the duct with an access panel for maintenance and testing.
4. All HVAC equipment shutdown and smoke control functions shall be initiated by addressable control module interface with the EMS system. Relays shall be mounted within three (3) feet of the EMS interface equipment.

5. The remote annunciator shall be mounted so that no switch, manually operated device, display, or LED is greater than 60-inches above the finished floor.
6. The manual pull station(s) shall be securely mounted with the operable part of the manual pull station at 46-inches above the finished floor.
7. Wall mounted audible/visual, audible and/or visual devices shall be mounted with their bottoms at 80-inches above the finished floor or 6-inches below the ceiling, whichever is lower.
8. Ceiling mounted audible/visual, audible and/or visual devices shall be mounted where shown on the drawings with their visual lenses having an unobstructed line of site in all directions. Exact locations of devices shall be sufficiently distant from vertical surfaces and hanging items to permit maximum viewing from all directions.
9. Weatherproof audible/visual notification device shall be mounted at the fire department connection on the building exterior and with the final location as acceptable to the AHJ.
10. Devices shall not be supported by ceiling tiles. Devices must be attached to a back-box supported by the ceiling grid.
11. At each door (man, overhead, counter, etc.) with magnetic hold opens, provide smoke detector(s) located in accordance with NFPA 72, whether shown on plans or not.
12. Provide seismic restraints of equipment and batteries per the criteria in section 260025.

C. Painting and Patching

1. All fire alarm conduit shall be thoroughly cleaned, removing all dirt, oil, etc. and made ready to receive paint.
2. Holes in walls or floors cut during the performance of this work shall be patched or covered with standard escutcheon plates so as to completely conceal the cuts where they would otherwise be exposed to view.
3. Firestop all penetrations of fire rated assemblies.

END OF SECTION 260721

SECTION 260723 - VIDEO SURVEILLANCE SYSTEM**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. The work of this section is the responsibility of this Contractor.
- B. Extent of the Video Surveillance System work is indicated by drawings. This contract requires the installation of PoE IP-based video cameras and an IP-based network video recorder (NVR) with provided software capable of being connected to the owners LAN. The system will be installed on the owner's network for viewing and playback.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. CCD: Charge-coupled device.
- D. FTP: File transfer protocol.
- E. IP: Internet protocol.
- F. LAN: Local area network.
- G. MPEG: Moving picture experts group.
- H. NTSC: National Television System Committee.
- I. PC: Personal computer.
- J. TCP: Transmission control protocol - connects hosts on the Internet.
- K. WAN: Wide area network.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's data and installation instructions for each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Calculations: Submit calculations for sizing NVR hard drive per paragraph 2.5-B below.
- C. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
 - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
 - 4. Wiring Diagrams: For power, signal, and control wiring.

- D. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cameras, power supplies, digital video recorders, media converters, video transceivers, cables and electronic copy of software to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include a list of spare parts and replacement components recommended to be stored at the site for ready access.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Comply with NECA 305, "Standard for installing Closed-Circuit Television Systems (CCTV)."
- E. Comply with UL 486A: Wire Connectors and Soldering Lugs for use with Copper Conductors
- F. Comply with 47 CFR – Telecommunication, Chapter I – Federal Communications Commission
- G. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of Video Surveillance systems, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- H. Equipment Supplier's Qualifications: Firms regularly engaged in design, programming and maintenance of video surveillance systems, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. Control Equipment: Rated for continuous operation in ambient temperatures of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
 - 2. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 14 to 100 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. General: Provide video surveillance cameras, of types, sizes, capacities and electrical characteristics indicated to provide a complete and operating system. Except as otherwise indicated, provide manufacturer's standard video surveillance system components as indicated by published product information, designed and constructed as recommended by manufacturer.
- B. All equipment and components shall be standard components regularly manufactured and used in the manufacturer's system.

2.2 CAMERAS

- A. Basis-of-Design Product: Axis Communications M42 Series.
- B. Indoor Fixed Camera: Assembled and tested as a manufactured unit, containing a white, polycarbonate and aluminum assembly, solid state color camera with PIR sensor, audio input and output and Power over Ethernet (PoE).
 - 1. Pickup Device: 1/4-inch, progressive scan RGB CMOS image sensor.
 - 2. Resolution: 3MP.
 - 3. Sensitivity: Scene illumination of 1.2 lux in color mode or 0 lux using internal illuminator.
 - 4. Motion Detector: Built-in PIR.
 - 5. Video Compression: H.264, Motion JPEG.
 - 6. Frame Rate: 30fps in all resolutions.
 - 7. Streaming: Multiple, individually configurable streams. Controllable frame rate and bandwidth.
 - 8. Power: PoE IEEE 802.3af Class 2 via RJ-45 connector.
- C. Outdoor Fixed Camera: Assembled and tested as a manufactured unit, containing a white, IP67 rated housing, solid state color camera with built-in IR illuminator, audio input and output and Power over Ethernet (PoE).
 - 1. Pickup Device: 1/2-inch, progressive scan CMOS image sensor.
 - 2. Resolution: 4k, 5 megapixel.
 - 3. Sensitivity: Scene illumination of 0.03 lux in color mode or 0.001 lux in black/white mode.
 - 4. Motion Detector: Triple window video motion detection.
 - 5. Video Compression: H.264, Motion JPEG and MPEG-4.
 - 6. Frame Rate: 30fps in H.264 and MJPEG or 25fps in MPEG-4 (1920x1080).
 - 7. Streaming: 3 simultaneous, individually configurable streams. Controllable frame rate, resolution and quality.
 - 8. Power: PoE IEEE 802.3af Class 3 via RJ-45 connector or 24VAC or 12VDC inputs.
- D. Outdoor PTZ Camera: AXIS Q6088-E
- E. Locate as shown on the plans.

2.3 POWER SUPPLIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Axis T8124-E High PoE midspan power supply with 100-240VAC input and 1 RJ45 output port.
1. Enclosure: Polycarbonate IP66.
 2. Wall mounted indoors, above ceiling space. Mounted in pole for exterior, pole mounted fixtures.
 3. Homerun cables from each camera to the power supply and from power supply to the network PoE switch.
 4. Indoor cameras shall receive power from the PoE switch. Exterior building mounted cameras shall receive power from the PoE switch. Exterior pole mounted cameras shall receive power from a 24 VAC external power supply connected to 120 volts.

2.4 NETWORK VIDEO RECORDERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ExacqVision A-Series IPS-XXXX-R2 or equivalent product by one of the following:
1. Bosch Security Systems, Inc.
 2. GE Security, Inc.
 3. Honeywell International Inc.; Honeywell Video Systems.
 4. JVC Americas Corp.; JVC Professional products.
 5. Panasonic Corporation of North America; Panasonic Security Systems.
 6. Samsung Opto-Electronics.
 7. Tyco International Limited; Sensormatic products.
 8. Vicon Industries, Inc.
- B. The NVR shall be equivalent to AXIS S1232 rack recording server. Expandable to 32 IP cameras, have pre-loaded Professional VMS Software, 32 TB maximum storage capacity, Windows 11, single power supply and appropriate number of IP licenses.
1. Video and audio recording over TCP/IP (LAN/WAN/Internet) network.
 2. H.264 video compression.
 3. Internal storage to be determined by supplier based on the following parameters: retain images for 30 days, 7.5 frames/sec, 50% compression using H.264, 50% motion for fixed cameras, 100% motion for PTZ cameras.
 4. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software through RJ-45 10/100/1000 Ethernet connection.
 5. Integrated Web server FTP server functionality.
 6. Integral DVD-RW, (8) USB ports, keyboard and mouse
 7. Provide rack mount kit for installation in a standard 19-inch wide equipment rack.

- C. Locate in telecommunications equipment rack as shown on plans.

2.5 SIGNAL TRANSMISSION COMPONENTS

- A. Cable: UTP Category 6 cable elements have 100-ohm nominal impedance. Comply with requirements in Section 260762 "Voice/Data Equipment and Wiring System."

- B. Video Transmission: UTP Category 6 cable from camera to network NVR inputs for interior or building mounted cameras; 50/125 um, OM3 multimode optical fiber from media changer at camera and NVR inputs. Provide media changer and power supplies.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

- A. Comply with requirements in Section 260110 "Raceways, Fittings and Boxes."
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
 - 1. Except raceways are not required in accessible indoor ceiling spaces and attics.
 - 2. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. For LAN connection and fiber-optic and copper communication wiring, comply with Section 260762 "Voice/Data Equipment and Wiring System."
- F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer. Ground rack mounted equipment to ground bus in rack.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install video surveillance system including components where indicated, in accordance with equipment manufacturer's written instructions, in compliance with the National Electrical Code, and with recognized industry practices, to ensure that video surveillance system complies with requirements and serves intended purposes.
- B. Install cameras with 84-inch minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

- C. Install power supplies and other auxiliary components at indicated electrical rooms, unless otherwise indicated.
- D. Use extreme care in handling, fishing and pulling-in electronic cable to avoid damage to cable. Avoid excessive and sharp bends.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Upon completion of installation of video surveillance components, and after circuitry has been energized with normal power source, test video surveillance systems to demonstrate capability and compliance with requirements.
- B. Tests and Inspections:
 - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
 - 2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
 - a. Prepare equipment list described in "Informational Submittals" Article.
 - b. Verify operation of auto-iris lenses.
 - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
 - d. Set and name all preset positions; consult Owner's personnel.
 - e. Set sensitivity of motion detection.
 - f. Connect and verify responses to alarms.
 - g. Verify operation of control-station equipment.
 - 3. Test Schedule: Schedule tests after pretests have been successfully completed and system has been in normal functional operation for at least 5 days. Provide a minimum of 10 days' notice of test schedule.
 - 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- C. Video surveillance system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide one visit to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
 - 1. Check cable connections.
 - 2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
 - 3. Adjust all preset positions; consult Owner's personnel.
 - 4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
 - 5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera domes and lenses.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 260723

SECTION 260762 – DATA EQUIPMENT AND WIRING SYSTEMS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Provisions of Division 01 apply to this section.
- B. Work in this section include but are not limited to:
 - 1. Furnishing, installation, testing and documentation of all elements for Owner's local area network (LAN) cable infrastructure.
 - 2. Furnishing all labor and materials to meet product performance requirements, general design considerations and installation guidelines.
 - 3. Responsibilities for labor, supervision, tooling, miscellaneous mounting hardware, cable management software, and consumables for systems installed.

1.2 RELATED SECTIONS

- A. Section 260000 - Basic Electrical Requirements.
- B. Section 260010 - Basic Electrical Materials and Methods.
- C. Section 260110 - Raceways, Fittings, and Boxes.

1.3 ACRONYMS

- A. ANSI - American National Standards Institute.
- B. BICSI - Building Industry Consulting Services International.
- C. BBS -Backbone Data Switch.
- D. DHCP - Dynamic Host Configuration Protocol.
- E. EIA - Electronic Industries Alliance.
- F. ESM - Edge Data Switch - Managed.
- G. ESU - Edge Data Switch - Unmanaged.
- H. FEP - Fluorinated Ethylene Propylene.
- I. HVAC - Heating, Ventilation and Air Conditioning.
- J. IDF - Intermediate Distribution Frame.
- K. IEEE - Institute of Electrical and Electronic Engineers.
- L. IP - Internet Protocol.
- M. ISA - Industry Standard Architecture.
- N. ISM - Intermediate Data Switch - Managed.
- O. LAN - Local Area Network.
- P. LDF - Local Distribution Frame.
- Q. LIU - Light Interconnection Unit. (Also FTU - Fiber Terminating Unit).
- R. MDF - Main Distribution Frame.
- S. MPOP - Main Point of Presence. (Also MPOE - Main Point of Entry).
- T. NEC - National Electrical Code
- U. OFNR - Optical Fiber Non-Conductive Riser.
- V. OTDR - Optical Time Domain Reflectometer.
- W. TIA - Telecommunications Industry Association.

- X. UL - Underwriters Laboratories Inc.
- Y. UPS - Uninterruptible Power Supply.
- Z. UTP - Unshielded Twisted Pair.

1.4 SYSTEM REQUIREMENTS

- A. Work shall include, but is not limited to the following:
 - 1. Provide MDF and IDF cabinets/racks on project site as indicated on drawings. MDF shall be located as close to the MPOP as practical. IDFs shall be located in designated spaces and in sufficient quantity to maintain compliance with the horizontal cable running distance limitations as specified in ANSI/TIA/EIA standard 568. Provide sufficient cabinet/rack space to allow a 50% expansion of the number of network data drops required by configuration as indicated on drawings. Leave space for at least one additional rack in the future.
 - 2. Provide and install pathway and cabling from the MDF to the MPOE.
 - 3. Furnish and install all appropriate LIU/FTU panels, connectors, patch cords, and cable management hardware internal to the cabinets/racks.
 - 4. MDF and IDF's shall consist of floor-mounted racks containing the space for data switches, UPS's, patch panels, patch cords, connectors, and wire management as required to distribute data drops to each workstation.
 - 5. Provide all pathways for horizontal and backbone cabling including J-hooks, cable tray, surface raceway, and/or conduit as indicated on drawings or as required per listed standards, whichever is more stringent.

1.5 SUBMITTALS

- A. Provide the following submittals in accordance with Section 260000.
 - 1. Material list: Submit a complete material list for the materials and products of this section. Each submittals shall be bound and shall contain an index.
 - 2. Product Data: Include product data sheets and/or catalog cut sheets for items listed in index. Items shall be arranged in the same order as the index and if more than one item is indicated, the submitted items shall be highlighted or marked with an arrow. Product data shall be sufficiently detailed to allow the Engineer to review the product and to allow other trades to provide necessary coordination.
 - 3. Shop Drawings: Provide shop drawings, in the same size as the drawings, prepared. Shop drawings shall indicate equipment locations, wiring schematics including point to point, panel and cabinet configurations, interfaces to equipment furnished by others, conduit and raceway sizes, cable counts, and termination locations. Background drawings may be obtained from the Architect in electronic version. Review shop drawings with Owners IT Representative.
- B. Installation and coordination drawings for items in other sections shall be included with submittal of shop drawings.

1.6 CODE AND STANDARDS

- A. UL
- B. National Electric Code – Including Articles 770 and 800 (latest issue).
- C. Occupational Safety and Health Association (OSHA) - National, state and local building and fire codes.
- D. ANSI/TIA/EIA 455, standard Test Procedures for Fiber Optics, Current issue.
- E. ANSI/TIA/EIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
- F. ANSI/TIA/EIA-568, Commercial Building Telecommunications Cabling Standards and Addendums, current editions.
- G. ANSI/TIA/EIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces, current issue.
- H. ANSI/EIA/TIA-598, Optical Fiber Cable Color Coding.
- I. ANSI/TIA/EIA-606, The Administration Standard for the Telecommunications Infrastructure of Commercial Building, current issue.
- J. ANSI/TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications, current issue.
- K. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue.
- L. TIA TSB-155, “Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10G Base-T”.
- M. IEEE 802.3 (Ethernet), 802.3Z (Gigabit Ethernet over optical fiber), 802.3ab (Gigabit Ethernet over 4-pair Category 5 or higher).
- N. BICSI Telecommunications Distribution Methods Manual (current edition).
- O. FCC Part 68.50.
- P. National Electrical Manufacturer’s Association (NEMA).
- Q. NECA / FOA 301, “Standard for Installing and Testing Fiber Optic Cables.”
- R. NECA / BICSI 568, “Standard for Installing Building Telecommunications Cabling.”

1.7 SYSTEM DESCRIPTION

- A. Telecommunications Cabling Infrastructure
 - 1. General: Network cabling infrastructure will utilize star topology design consisting of horizontal cabling, backbone cabling and various telecommunications cabling pathways

and spaces. Following project drawings, Contractor shall determine the best route and method for cable conveyance throughout the building in accordance with Owner standards.

2. Horizontal Cabling: Data outlets, unless otherwise noted, shall be furnished with **two** Cat 6, RJ45 receptacle. Cat 6 cables shall be terminated on 8-position, 8-conductor Cat 6 (RJ45) jacks wired in accordance with T568B. Associated faceplates shall accommodate four jacks at a minimum. Within the room, the cabling shall be routed via in-wall conduit or surface mount raceway into the data outlet as close to each workstation as practical. Provide extended sleeves to cross over hard tile ceiling areas and other inaccessible areas. Provide concealed cable tray where shown. Provide Cat 6 rated patch panels and all necessary patch cords for telecommunications spaces, cabinets and workstations to maintain a Cat 6 channel for horizontal cabling.
3. Backbone Cabling: The backbone cabling, unless otherwise noted, shall consist of 12-strand multi-mode and 6-strand single-mode fiber optic cabling for inter-building and intra-building backbone cabling. Connectors, optical fiber patch cords, distribution panels, ferrules, enclosures, cable tray, and consumables shall be included to provide backbone connectivity between each MDF and IDF.
4. Telecommunications Spaces: Telecommunications spaces shall be located in secure areas with 24 hr./7 day temperature control and ventilation, power, lighting, and grounding. MDF and IDF spaces will accommodate horizontal and backbone cabling termination equipment including free-standing cabinets/racks, patch panels, vertical and horizontal wire management, patch cables, ladder racking, conduit sleeves, and data electronics.

B. Color Coding requirements

1. Access control: purple cables and patch cords
2. Cameras: Purple Cables and patch cords
3. Wireless Access Points: White cables and patch cords
4. TV locations/AV hardware: Green Cables and patch cords.
5. Standard Data: Blue cables and patch cords
6. SCADA: Orange cables, patch cords, and jacks.
7. Network connections: Red cables

1.8 QUALITY ASSURANCE

- A. The work of this section shall conform to applicable codes and standards.
- B. The work of this section shall be provided by an installer that has completed at least 5 projects of equal scope to the specified systems and shall have been engaged in the business of supplying and installing the type of specified systems for at least 5 years. Include the telephone number of the customer's client contact for each of the 5 projects.

- C. Provide a 2 year material and labor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fiber optic and data cables shall be manufactured by Belden, Hitachi/Proterial Cable America, Berk-Tek, Corning (fiber only) or approved equal.
- B. Cabinets / racks, data inserts, patch panels, faceplates and other accessories shall be manufactured by Ortronics, Hubbell, Panduit, Leviton or approved equal.

2.2 EQUIPMENT STANDARDS

- A. All components installed shall be listed by UL.
- B. Equipment requirements
 - 1. In order to establish a standard of quality as required by the Owner, various manufacturers' equipment may meet the requirements in this document. As a reference for comparison of vendors, the equipment specification sheets on items shall be included with the submittal.
 - 2. The Engineer will determine compliance of product or components offered for use under this Contract.

2.3 CABLING REQUIREMENTS

- A. Underground pathways: Schedule 40 PVC conduit conforming to UL 651.
- B. Interior Metallic Conduit:
 - 1. Electric metallic tubing (EMT) shall be rated in accordance with UL 797.
 - 2. Distribution cable shall be routed through an interior EMT wall sleeve from the data outlet to the interstitial ceiling space adjacent to the designated horizontal return, i.e. J-hooks and cable tray.
- C. Multi-Mode Fiber Cables
 - 1. Optical fiber shall be multi-mode, graded index, optical fiber wave guide with nominal 50/125mm-core/cladding diameter rated to OM3 criteria. The optical fiber shall comply with ANSI/EIA/TIA-492.
 - 2. Mechanical and environmental specifications for multi-mode fiber distribution cables shall be indoor/outdoor, tight-buffered type cables. The cable shall meet the requirements of NEC Section 770. Confirm that the cable is listed for the specified application.
 - 3. Cabled optical fibers shall meet the graded performance specifications of ANSI/TIA/EIA 568. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, -53 or -61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or -30. The cable shall be measured at 23 degrees C and 5 degrees C.

4. Multi-mode fiber optic cable shall meet the following minimum performance requirements
 - a. Laser-optimized, OM3 performance.
 - b. minimum bandwidth capability at 850 nm: 2000 MHz/kilometer.
 - c. maximum attenuation at 850 nm: 3.25 dB/kilometer.
 - d. maximum attenuation at 1300 nm: 1 dB/kilometer.
 5. Utilize gigabit enhanced 50/125 multi-mode fiber; provide performance warranty that the multi-mode optical cable will support 10G base ethernet transmission up to 300 meters and 100G base up to 100 meters at 850 nm using LX optics.
- D. Single-Mode Fiber Cables
1. Single-mode optical fibers shall be Class Iva dispersion-unshifted single-mode optical fibers and shall comply with ANSI/EIA/TIA-492. Fiber conductors shall have nominal core diameter of 8.7 microns. Cables shall have transmission window centered at 1310 nm and 1550 nm wavelengths.
 2. Mechanical and environmental specifications for single-mode fiber distribution cables shall be indoor-outdoor, tight-buffered type cables. Cables shall meet the requirements of NEC Section 770. Contractor shall confirm the cable is certified for the specified application.
 3. Cabled optical fibers shall meet the attenuation performance specifications of table ANSI/TIA/EIA 568 A, Chapter 12, Table 12-3. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78A or -61. Cables shall be measured at 23 degrees C and 5 degrees C.
 4. Single-mode fiber optic cable shall meet the following minimum performance requirements:
 - a. maximum attenuation at 1310 nm: 1.0 dB/kilometer (inside cables).
 - b. maximum attenuation at 1550 nm: 1.0 dB/kilometer (inside cables).
- E. Fiber Optic Connectors shall be duplex angled, LC type, MM or SM connectors as appropriate.
- F. Fiber Optic LIU (also FTU): Rack-mounted with the capacity to handle 12, 24, 48, 72 or 144 ports. LIUs shall be sized to accommodate terminated strands with a 25 percent future expansion capacity. Complete kit shall include panel bulkheads and supporting hardware bulkheads with built-in cable management.
- G. Fiber Optic Jumper Cables
1. Multi-mode 50/125 or single-mode duplex cable, OFNR-rated. Length shall be 1 meter at minimum, pre-manufactured with LC-LC connectors with same transmission characteristics as the terminated fibers.
 2. Fiber optic patch cables shall be jacketed with polyvinyl chloride with yellow indicating a single-mode patch cable and aqua indicating a multi-mode patch cable. The cable shall meet requirements of TIA/EIA-568-B.3 except where more stringent requirements on bandwidth and attenuation are specified.

- H. Fiber Optic Inner Duct: Provide one inch and/or one and one-half-inch corrugated with pull rope, rated as required by code or as indicated on drawings.
- I. Cat 6 Cable: Horizontal cabling shall be 4-pair UTP, UL and NEC rated, with appropriately rated PVC jacket. Individual conductors shall be FEP insulated. Cable shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT and PSELFEXT for 4-pair Cat 6 cabling as detailed in ANSI/TIA/EIA-568-C.2.
- J. Data Inserts: Data inserts shall be wired to the T568-B wiring pattern. Data inserts shall meet minimum requirements for return loss, propagation delay, delay skew, NEXT loss, FEXT loss, ELFEXT, and PSELFEXT for connecting hardware in accordance with ANSI/TIA/EIA-568.
- K. Patch Cords: Patch cords shall be rated to match horizontal cabling. Patch cords shall be factory assembled by the manufacturer of the cabling system.
- L. Patch Panels: Patch panels shall be provided in 24 or 48-port compliments with modular jack ports wired to T568-B. Patch panels shall be augmented with cable support bars in rear to properly dress cable. Patch panels shall meet minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for connecting hardware in accordance ANSI/TIA/EIA-568.
- M. Outlet Gang Boxes: As a minimum, telecommunications outlet boxes shall be capable of housing 4 Cat 6 terminations. Telecommunications outlet/connector box shall consist of a 4"x4"x2-1/8" deep electrical box.
- N. Faceplates: Faceplates shall be constructed of ABS molding compound and have the ability to accommodate four inserts or as required by cable terminations. Colors shall be similar receptacle outlets in Section 260140.
- O. Floor-standing Cabinets: Floor-standing equipment cabinets for MDF or IDF installation use as required. If an MDF cabinet contains more than eight EIA rack spaces of structured cable components, a second floor-standing cabinet shall be provided. In the event that two cabinets are provided in the MDF, all structured cabling components shall be installed in the same cabinet. Cabinets shall provide at least 84 inches of total mounting space for 19-inch panels and 24 inches of interior depth. Cabinet shall be constructed of a minimum of 14 gage steel, with adjustable mounting rails tapped for No. 10-32 screws on EIA spacing front and rear, and shall be provided with Zone 4 earthquake reinforcing kits. Cabinet shall be provided with the following:
 - 1. Thermostatically controlled heat dissipation fan.
 - 2. Textured antique finish.
 - 3. Matching side panels and louvered top panel.
 - 4. Hinged, key-locking, removable bronze-tinted acrylic window door in front.
 - 5. Full-length, removable hinged, key-locking rear door.
 - 6. Both doors shall be able to swing fully open.
- P. Wall-Mounted Cabinet: Wall-mounted equipment cabinets shall provide at least 45 inches of mounting space for 19-inch panels (26 rack spaces) and 24 inches of interior depth. No more than one third of the mounting space in a cabinet may be occupied by structured cable components. Cabinets shall be welded steel construction with 14 gage carbon steel mounting

rails, tapped for No. 10-32 screws on EIA spacing, fully adjustable front-rear. Cabinets shall be provided with top or side ventilation capability and a thermostatically controlled heat dissipation fan, a plexi-glass front door, and locks on both front and rear sections, and shall be provided with white, powder coat finish.

- Q. Terminal Boards: 3/4 inch fire retardant fir plywood, painted two coats on both sides to match room finish and all edges, of size indicated on drawings; Maintain visibility of fire retardant stamp on each board. Anchor the board to the wall with bolts or screws and 1/4 inch washers.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABLE SYSTEM

- A. Site conditions: Contractor shall examine the areas and conditions under which the work of this section will be performed. Report unsatisfactory conditions to the Engineer before work begins.
- B. Conduit subsystem
1. Excavation: Refer also to Section 260010.
 - a. Notify the Owner at least 24 hours prior to excavation.
 - b. Before excavation, contact the utilities for information on buried utilities and pipelines.
 2. Conduits: Refer also to Sections 260110 and 260115.
 - a. Construct underground ductbanks of individual conduits supported by minus with plastic spacers. Ducts shall not be smaller than 4 inches in diameter unless otherwise specified. Provide mule tape in each conduit.
 - b. Provide plastic duct spacers between ducts, at a maximum 5 feet on center.
 - c. The top of the conduit shall not be less than 30 inches below grade.
 - d. Ductbanks shall have a continuous slope downward toward ground vaults and away from buildings with a pitch of not less than 4 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Manufactured bends shall have a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
 - e. Stagger joints of the conduit by rows and layers so as to provide a duct line having maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of a duct line is completed from ground vault to ground vault, draw a stiff bristle brush of the proper diameter through each duct until the conduit is clear of particles of earth, sand, and gravel; then immediately re-install conduit plugs.

- f. Conduits may be installed to exterior and interior portions of a building to extend conduit from ground vaults to the building MDF or IDF. Install in the shortest path and comply with BISC standards. Conduit shall be EMT or rigid metal conduit depending upon conditions and exposure to elements. EMT may only be installed in concealed spaces unless specifically approved by the Engineer.
 - g. Interior, in-wall, conduits for multiple cables to communication outlets are to be a minimum of 1 inch and dedicated conduits shall serve outlet boxes.
 - h. Empty conduits shall be installed with pull string and insulated bushing for future installations.
 - i. Interior conduit runs without pull boxes shall not exceed 100 feet in length and shall not contain more than 2 bends of 90 degrees each. Exterior and underground conduit runs shall not exceed 200 feet and shall not contain more than two 90 degree bends between pullboxes or vaults. If more than 2 bends of 90 degrees are required, the conduit run shall be increased by one trade size. Distances of up to 600 feet between underground pull boxes may be allowed if the conduit run between pull boxes has no bends, and is indicated on drawings.
 - j. Interior pull boxes shall be accessible. Pull boxes shall not be installed above hard lid ceilings, HVAC ducts, or mechanical piping. Pull boxes shall not be installed in place of bends.
 - k. Conduit types shall be limited to rigid metal conduit, electrical metallic tubing (EMT), and Schedule 40 PVC, as permitted under Section 260110.
 - l. Conduit shall be sized in accordance with Table 4.4-1, EIA/TIA-569 except as noted herein.
 - m. Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.
 - n. UL-approved fire-stop compound applicable to installation shall be used when penetrating fire-rated walls and floors.
 - o. Refer to Attachment A at the end of this section for additional specifications for conduit sizing. Conduit fill shall not exceed 40%.
3. Ground Vaults and Pull Boxes
- a. Ground vaults and pull boxes shall be installed in paved areas with each box a minimum of one foot clear to edge of paving. The top of boxes shall be installed at the same elevation of finish surface of paving, or 2 inches above finished grade if installed in earth. Install boxes where runoff water will not drain to or into the box.
 - b. Provide pulling irons on opposite walls and below horizontal centerlines of ducts and cemented openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.

- c. Install a floor drain into a sump containing 2 cubic yards of crushed rock, minimum size 48 inches deep, and 36 inches diameter. Provide a 36-inch length of 6-inch diameter tile pipe extending down into sump and fill with gravel. Cover sump with grille.
 - d. Install a ground rod in each concrete pull box. Locate near a wall with a 6 inch projection above finished grade for installation of grounding clamps. Permanently bond and ground metal equipment cases, cable racks, and other metal objects in pull boxes. Grounding conductors shall be #6 gage bare stranded copper.
 - e. Cable splicing is not permitted.
4. Data Cable Termination Installation
- a. Patch panels shall be installed in 24 or 48 port compliments. Contractor shall provide and install all necessary patch cords, both copper and fiber optic, for internal cabinet interconnections.
 - b. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel.
 - c. Cables shall be dressed and terminated in accordance with TIA/EIA-568, manufacturer recommendations, and this specification.
 - d. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.
 - e. Cables shall be neatly bundled, not overly tight, and dressed to their respective panels or blocks.
 - f. The cable jacket shall be maintained as close as possible to the termination point. Pair untwist shall be limited to ½".
 - g. Patch cords installed in racks or cabinets shall be complimentary to horizontal cabling.
 - h. Contractor shall terminate both ends of cable, unless noted otherwise.
5. MDF / IDF Fiber Termination Hardware Installation
- a. Fiber slack shall be neatly coiled within the fiber termination panel. No slack loops shall be allowed external to the fiber panels.
 - b. All cables shall be individually attached to the respective termination panels by mechanical means.
 - c. Each fiber cable shall be stripped upon entering termination panels and the individual fibers routed neatly into termination panels.
 - d. Dust caps shall be installed on unused connectors and couplings.
6. Racks/Cabinets

- a. Racks and cabinets shall be floor- or wall-mounted, as required, and provided with tip bars and additional accessories as required for a complete functional system. Racks and cabinets shall be seismically braced and attached to horizontal ladder racking or cable tray with 3/4 inch threaded rod. Calculations shall be based on the maximum load rating of the cabinet by the manufacturer in a Zone 3 seismic environment, not the weight at time of occupancy. MDF racks or cabinets shall support a minimum of 750 pounds of static weight. IDF racks or cabinets shall support a minimum of 250 pounds of static weight.
 - b. There shall be enough space in the front and rear of MDF/IDF cabinets to accommodate 31-inch aisles.
 - c. Bond together cable grounds to distribution rack, and bond rack to building electrical panel ground for grounding continuity. Continuity shall be checked with an ohmmeter between adjacent components. Submit written certification to the Owner that the tested ohmmeter readings do not exceed one ohm. Equipment racks shall be grounded to building ground in accordance with EIA/TIA 607.
 - d. Provide keys and locks for cabinets and equipment.
7. Backbone Cabling
- a. Proper bending radius and pulling strength requirements of cables shall be followed during handling and installation. Cables, splice cases, punch-down frames, patch panels and supporting hardware shall be installed in accordance with manufacturer recommendations.
 - b. Outside plant fiber shall be installed in 1-1/2 inch or one inch corrugated inner duct installed within the backbone conduit.
 - c. Interior innerduct and cable shall be plenum or riser rated, as required by applicable code regulation or standard. Riser rated innerduct as a minimum shall be installed on floor-to-floor fiber optic cabling.
 - d. Interior fiber shall be installed in conduit or raceway unless installed in the cable tray system where corrugated innerduct shall be used. Innerduct runs without conduit shall be installed properly strapped and supported every 4 feet. Innerduct shall be rated for indoor or outdoor use as applicable.
 - e. Cables in panels, cabinets, trays, and rack shall be neatly grouped and strapped using tie-wrap cable straps. Cables and panels shall be clearly identified at both ends with a unique cable numbering system and in compliance with TIA 606.
 - f. All fiber optic strands shall be terminated.
 - g. Refer to Part 1, System Description and plans for backbone cabling requirements.
8. Horizontal Cabling

- a. Horizontal distribution cable for data circuits from an MDF or IDF to data outlets shall be Cat 6, 4-pair unshielded twisted pair, CMP or CMR rated as required. Quantities of cables to each outlet shall be in accordance with the plans.
 - 1) Cable shall be installed in accordance with manufacturer recommendations.
 - 2) Cable raceways shall not be filled greater than NEC maximum fill for the particular raceway type, normally 40%.
 - 3) Cables shall be installed in continuous lengths from origin to destination.
 - 4) Minimum bend radius and maximum pulling tension shall not be exceeded.
 - 5) If a J-hook or trapeze system is indicated on the drawings, support horizontal cable bundles installed above ceilings at a maximum of 5 foot intervals. A minimum of 6 inches of clearance between ceiling grid and cable bundle shall be maintained. Cables shall not rest on acoustic ceiling grids or tiles. J-hooks and trapeze systems shall be installed only where indicated on the drawings.
 - 6) Cable shall be installed above mechanical ducting and water lines and shall not be attached to other systems, equipment or hardware.
 - 7) Cables shall not be attached to ceiling grid or lighting fixture support wires.
 - 8) Cable that is damaged or subjected to installation practices outside of those specified within this document shall be replaced by the Contractor at no charge to Owner.
 - 9) Unshielded twisted pair cable shall be installed so that there are no bends less than 4 times the cable outside diameter.
 - 10) Pulling tension on 4-pair UTP cables shall not exceed 25 pounds for a single cable or bundled cable.
9. Labeling and Marking
 - a. Provide complete cable location chart and as-built documentation in an envelope and attach to the rack/cabinet.
 - b. Mark distribution panels, cables and coverplates with computer-generated labels. Drops shall be labeled with the same identifier on the receptacle faceplate, inside the junction box, on the cable at the jack, on the cable at the patch panel, on the termination side of the patch panel, and on the patch side of the patch panel. Cable markers shall be located within 2 inches of the end of the cable jacket and shall be directly readable. Panel labels shall be computer-generated and printed using a laser printer. A disk with the label files shall be submitted as part of the project record documents.

- c. Cable Identification Methodology: Utilize the room numbers of the facility to identify individual drops for new and existing facilities. Room number shall be comprised of the first three digits of the numbering scheme. In large facilities requiring more than three digits or in facilities with alpha-numeric room identifiers, adjust the numbering scheme accordingly. Backbone identifiers at the MDF shall indicate the IDF that it feeds. Identifiers shall be unique and in compliance with TIA 606.

C. Surge Protection Devices

1. Where metallic cabling leaves the building above or below grade to an exterior device, provide surge protection where the cabling exits the building. Where devices are mounted to an exterior wall and cabling does not extend past the building façade, surge protection may be omitted. Surge device shall be equivalent to Ditek.

3.2 CERTIFICATION AND TEST OF CABLING SYSTEM

- A. Cables and termination hardware shall be 100 percent tested for defects in installation and to verify cable performance under installed conditions. Conductors of installed cables shall be verified. Defect in the cabling system installation including, but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100 percent effectiveness.

B. Copper

1. Cables shall be tested for continuity on pairs and/or conductors.
2. Data cables shall be performance verified using an automated test set.
3. This test set shall be certified level IIIe. Provide the Owner with copies of factory calibration certificated for each test set. To ensure verifiable equipment calibration, the Owner may require field calibration each time a new set of tests are performed. Tester shall be capable of testing for the continuity parameters defined above, and provide results for the following tests:
 - a. Attenuation
 - b. Ambient noise.
 - c. Attenuation to cross-talk ration (ACR).
 - d. Pair-to-pair near-end cross-talk (NEXT) loss (new limits).
 - e. Power sum near-end cross-talk (PSNEXT) loss.
 - f. Return loss.
 - g. Far-end cross-talk (FEXT).
 - h. Pair-to-pair equal level far-end cross-talk (ELFEXT).
 - i. Power sum equal level cross-talk (PSELFEXT).
 - j. Propagation delay.
 - k. Delay skew.
 - l. Cable length verification.
 - m. Wire map.

4. Test results shall be automatically evaluated by equipment, using the most up-to-date criteria from the ANSI/TIA/EIA-568 standards and addendums.
5. Test results shall be printed directly from the test unit in native format, and both hard and soft copies in native format shall be provided to the Owner. The printed test results shall include tests performed, the expected test result, and the actual test result.

C. Fiber Optics

1. Terminate, test, and document multi-mode and single-mode fiber optic cables with connectors at the drop locations and on fiber optic patch panels at the MDF and IDFs.
2. Fiber optic cable shall meet EIA/TIA performance standards and shall be tested in accordance with applicable standards. Light source and power meter tests shall be dual wavelength and bi-directional, while OTDR tests shall be performed from the MDF with sufficient launch cables installed at both ends of the fiber run to clearly identify the mated connectors.
 - a. Multi-mode fiber optic cable runs shall be tested in both directions at both wavelengths with a power meter and light source combination that can verify distance and attenuation at each wavelength.
 - b. Single-mode fiber optic cable runs less than or equal to 100m shall also be tested in both directions at both wavelengths with a power meter and light source combination that can verify distance and attenuation at each wavelength.
 - c. Single-mode fiber optic cable runs greater than 100m shall be tested with an OTDR, light-source and power meter.

3.3 PROJECT RECORD DOCUMENTS

- A. In addition to requirements specified in other sections, submit the following project record documents to the Engineer.
 1. As-built drawings indicating equipment locations, wiring types, panel configurations, sizes and a point-to-point-wiring diagram of all circuits. Drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details.
 2. Test results: Submit test results to the Engineer.

3.4 PROTECTION

- A. Protect the work of this section until substantial completion.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the project site.

CONDUIT CAPACITY CHART											
Inside Diameter mm	Trade Size in.	Cable Outside Diameter									
		mm (in.)									
		3.3 (0.13)	4.6 (0.18)	5.6 (0.22)	6.1 (0.24)	7.4 (0.29)	7.9 (0.31)	9.4 (0.37)	13.5 (0.53)	15.8 (0.62)	17.8 (0.70)
16	½	1	1	0	0	0	0	0	0	0	0
21	3/4	6	5	4	3	2	2	1	0	0	0
27	1	8	8	7	6	3	3	2	1	0	0
35	1-1/4	16	14	12	10	6	4	3	1	1	1
41	1-1/2	20	18	16	15	7	6	4	2	1	1
53	2	30	26	22	20	14	12	7	4	3	2
63	2-1/2	45	40	36	30	14	14	12	6	3	3
78	3	70	60	50	40	20	20	17	7	6	6
91	3-1/2							22	12	7	6
103	4							30	14	12	7
CONDUIT PULL BOX CHART											
Maximum Trade Size of Conduit		Size of Box						For each Additional Conduit Increase Width by:			
		Width		Length		Depth					
21 mm (3/4 in.)		100 mm (4 in.)		300 mm (12 in.)		75 mm (3 in.)		50 mm (2 in.)			
27 mm (1 in.)		100 mm (4 in.)		400 mm (16 in.)		75 mm (3 in.)		50 mm (2 in.)			
36 mm (1-1/4 in.)		150 mm (6 in.)		500 mm (20 in.)		75 mm (3 in.)		75 mm (3 in.)			
41 mm (1-1/2 in.)		200 mm (8 in.)		675 mm (27 in.)		100 mm (4 in.)		100 mm (4 in.)			
53 mm (2 in.)		200 mm (8 in.)		900 mm (36 in.)		100 mm (4 in.)		125 mm (5 in.)			
63 mm (2-1/2 in.)		250 mm (10 in.)		1050 mm (42 in.)		125 mm (5 in.)		150 mm (6 in.)			
78 mm (3 in.)		300 mm (12 in.)		1200 mm (48 in.)		125 mm (5 in.)		150 mm (6 in.)			
91 mm (3-1/2 in.)		300 mm (12 in.)		1350 mm (54 in.)		150 mm (6 in.)		150 mm (6 in.)			
103 mm (4 in.)		375 mm (15 in.)		1520 mm (60 in.)		200 mm (8 in.)		200 mm (8 in.)			

END OF SECTION 260762

SECTION 260770 - INTRUSION DETECTION SYSTEM**PART 1 - GENERAL****1.1 SUMMARY**

- A. It is the intent of these specifications to describe the requirements for the complete installation of an intrusion detection system.
- B. The Electrical Contractor shall provide all equipment, accessories, materials, services and labor required to install the system, including raceways, outlet and pull boxes, wiring and all other equipment required to complete, test and adjust the system for proper and successful operation.
- C. The Electrical Contractor shall submit complete shop drawings for the system. Submittal shall include catalog cuts of equipment showing construction features, dimensions, operational components, and other information necessary for evaluation of the system proposed.

1.2 SERVICE AND WARRANTY

- A. The system shall be guaranteed by the Contractor for the period of one (1) year after acceptance. Contractor, or sub-contractor, shall have a recognized service organization capable of providing complete 24-hour on-premise service.
- B. Service during the one (1) year guarantee period shall be provided free of any charge for labor or materials, providing service can reasonably be performed during normal working hours. During non-normal hours, regular rates shall be paid by Owner.

PART 2 - PRODUCTS**2.1 CONTROL PANEL**

- A. Control panel shall be microprocessor based and capable of utilizing both hardwired and multiplexing wiring techniques. Specified equipment is manufactured by Ademco model VISTA-128BPT. Other panels manufactured by Radionics or Napco shall be considered equal if they are supplied and configured to meet all specified capacities and functions.
- B. Control panel shall be capable of monitoring 9 hardwired zones expandable to 75 with a polling loop module. Provide polling loop module under this contract. The system shall support 8 partitions total.
- C. Each motion detector and door contact shall report as a separate and distinct point on the English Language display on the Control Annunciation Station.

2.2 ANNUNCIATION STATION

- A. Shall display the status of the system and all points within the system on an alpha/numeric English Language display.
- B. Shall contain a built-in sounder that will produce warning or exit/entry tones.
- C. Upon request shall list status of all points within the systems.

- D. Provide display keypad as shown on plans.
- E. Shall be equivalent to Honeywell 6460W – Premium Alpha Keypad Family.

2.3 ASSOCIATED EQUIPMENT

- A. Magnetic contacts are specified in the access control specification section.
- B. Motion detectors shall be wall mounted PIR devices that communicate with the control panel as a unique address. Provide Bosch DS-CL15 (wall mounted) and Bosch DS-DS938Z (ceiling mounted) addressable wide area detectors where indicated on plans.
- C. Indoor siren shall be Ademco 747F.
- D. Total system shall operate on battery back-up. Provide a 7 AH battery for system back-up.
- E. Cables shall be provided as recommended by the manufacturer and shall be plenum rated.
- F. A method of entry shall be provided to local Fire Department for emergency situations. Exact method shall be determined with local Fire Marshal (e.g., remote switch, keypad, etc.)
- G. Glass Break detectors shall be wall or ceiling mounted that communicate with the control panel as a unique address. Provide Honeywell model FG-1625 or equivalent.
- H. Self-contained siren/strobe for indoor and outdoor use shall be W Box technologies OE-OUTDSIRSB

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Electrical contractor shall enlist the field consultation services of the manufacturers' representatives trained technicians to insure proper wiring, installation and programming of the system.
- B. Central station monitoring shall be provided by owner.
- C. Provide raceways and boxes as required. Raceways shall be provided for all concealed calling in walls and above inaccessible ceilings. Coordinate box sizes and depth with manufacturer's requirements.

END OF SECTION 260770

SECTION 260935 – TIME SWITCHES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260000 - Electrical General Conditions.
- C. Section 260010 - Basic Electrical Materials and Methods.

1.2 WORK INCLUDED

- A. Time switches.

1.3 QUALITY ASSURANCE

- A. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate electrical service connections on shop drawings or product data.
- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

PART 2 - PRODUCTS**2.1 ELECTRONIC TIME SWITCH**

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Intermatic ET2845C (4 circuit), ET2825C (2 circuit), or ET2805C (1 circuit) series.
 - 2. Paragon
 - 3. Tork
- B. Time switch shall be a 7-day/365-day Astronomic Electronic Time Switch with solid state electronic control capable of permitting 56 Event set points per circuit to be distributed on independent daily schedules. 4, 2, or 1 Circuits.
- C. The time switch shall include a 7-day repeat feature for simplifying programing of set points.
- D. The timer shall have a digital LCD readout to show day of week, time-of-day and date using 12 hour AM/PM indicator.

- E. The time switch shall provide a manual override control for both temporary and/or override.
- F. The time switch shall operate over a temperature range of -40°F to 104°F.
- G. No maintenance super capacitor shall protect time-of-day for a minimum of 100 hours; program information shall be in non-volatile memory.
- H. Switch configuration to be SPDT with a UL/CSA listed rating of:
 - 1. 30 amp Inductive/Resistive, 120/240 volts AC, 60 Hz
 - 2. 10-amp Electronic Ballast (LED) 120/277 volts AC, 60 Hz
 - 3. 1 HP, 120 volts AC, 60 Hz
 - 4. 2 HP, 240 volts AC, 60 Hz
 - 5. 5 amps Tungsten, 120/240 volts AC, 60 Hz
 - 6. 20 amps Ballast, 120/277 volts AC, 60 Hz
- I. The time switch shall be 120 - 277 volts AC, 60Hz
- J. The time switch shall be enclosed in a lockable steel NEMA 1 rated enclosure, unless noted otherwise.
- K. The time switch shall be UL/CSA listed under UL 916/C22.2-177.

PART 3 - EXECUTION

- 3.1 Coordinate all locations, size, and installation details of the time switches with the anticipated building construction to insure that they fit the space provided for them.
- 3.2 WIRING INSTALLATION
 - A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
 - B. Size conductors according to control device manufacturer's written instructions, unless otherwise indicated.
 - C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- 3.3 IDENTIFICATION
 - A. Identify components and power and control wiring according to Section 260010.
 - B. Identify controlled circuits in lighting contactors.
 - C. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
 - D. Label time switches and contactors with a unique designation.
- 3.4 FIELD QUALITY CONTROL
 - A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Control devices that fail tests and inspections are defective work.
- 3.5 ADJUSTING 916/C22.2-177
- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- 3.6 DEMONSTRATION
- A. Coordinate demonstration of products specified in this Section with demonstration requirements in other Division 26 Sections.
- 3.7 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260935

SECTION 260937 – PHOTO CONTROL**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260000 - Electrical General Conditions.
- C. Section 260010 - Basic Electrical Materials and Methods.

1.2 WORK INCLUDED

- A. Photo Control

1.3 QUALITY ASSURANCE

- A. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate electrical service connections on shop drawings or product data.
- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

PART 2 - PRODUCTS**2.1 PHOTO CONTROL**

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Intermatic EK4436SM
 - 2. Tyco Electronics AT-20
 - 3. Tork 2107
- B. The photo control shall provide automatic switching for outdoor lighting loads.
- C. Control shall be a thermal design with built-in delay to ensure that the controlled lighting does not switch off due to ambient light or lighting striking the photocell.
- D. Photo control shall be conduit or box mounted die cast metal and have ratings as follows:
 - 1. Voltage: 120-277

2. Tungsten Load (Watts): 2000
3. Ballast Load (VA): 1800
- E. Photo control ballast based on UL testing at 50% power factor for ballast loads.
- F. Photo control shall provide switching volts $\pm 10\%$ to accommodate fluctuations in supply voltage.
- G. Components shall consist of a metal film resistor dual temperature compensating bi-metal blades, snap action contact blades, chemically treated / polymer encapsulated cadmium sulfide photocell and silver alloy contacts to ensure reliable 5 year manufacturer warranted operation.
- H. Photo control shall 100% factory tested for function within specified light levels.
- I. Photo control shall be UL listed and shall meet all applicable agency requirements.
- J. Photo control shall function over temperature range of -40F to 140F.

PART 3 - EXECUTION

- 3.1 Coordinate all locations, size, and installation details of the photo control with the anticipated building construction.
- 3.2 Where raceways penetrate the roof seal, provide suitable conduit boots compatible with the roofing material and stainless steel draw band for a weather tight installation.
- 3.3 Photo cells shall be installed in an unobstructed area with photo eye facing north.
- 3.4 Photo cell shall be in an approved outdoor junction and weatherproof cover plate.
- 3.5 WIRING INSTALLATION
 - A. Minimum conduit size shall be 1/2 inch.
 - B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
 - C. Size conductors according to control device manufacturer's written instructions, unless otherwise indicated.
 - D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- 3.6 IDENTIFICATION
 - A. Identify components and power and control wiring according to Section 260010.
 - B. Identify controlled circuits in lighting contactors.
 - C. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

- D. Label time switches and contactors with a unique designation.

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Control devices that fail tests and inspections are defective work.

3.8 ADJUSTING 916/C22.2-177.

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements in other Division 26 Sections.

- 3.10 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260937

SECTION 260938 – OCCUPANCY SENSORS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260000 - Basic Electrical Requirements.
- C. Section 260010 - Basic Electrical Materials and Methods.
- D. Section 260500 - Interior Lighting.

1.2 WORK INCLUDED

- A. Occupancy sensors.

1.3 QUALITY ASSURANCE

- A. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate electrical power connections on shop drawings or product data.
- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

PART 2 - PRODUCTS**2.1 OCCUPANCY SENSORS**

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:

- 1. Sensor Switch
- 2. Watt Stopper
- 3. Leviton

- B. Occupancy sensors shall be equivalent to the following Sensor Switch types:

<u>Type</u>	<u>Model</u>	<u>Mounting</u>	<u>Tech.</u>	<u>Voltage</u>	<u>Coverage</u>	<u>Rating</u>
A	WSD PDT	Wall with override	Dual, 1 Pole	Line	180° beam; 20' small motion, 50' large motion (4' mounting height)	800VA at 120V 1200VA at 277V ¼ HP motor load

B	WSD PDT LV	Wall with override	Dual, 1 Pole	Low	180° beam; 20' small motion, 50' large motion (4' mounting height)	12-24V, use with power pack, PP20
C	CM- PDT-9	Ceiling	Dual, 1 Pole	Low	360° beam; 12' radial coverage (9' mounting height)	12-24V, use with power pack, PP20
D	CM- PDT-10	Ceiling	Dual, 1 Pole	Low	360° beam; 28' radial coverage (9' mounting height)	12-24V, use with power pack, PP20
E	CM-6	High Bay	PIR, 1 Pole	Low	360° beam; up to 45' mounting height, 15' radial coverage.	12-24V, use with power pack, PP20
F	WSX-PDT-D	Wall with override Dimmer	Dual, 1 Pole	Line	180° beam; 20' small motion, 36' large motion (4' mounting height)	800VA at 120V 1200VA at 277V, ¼ HP motor load

- C. Provide all necessary sensors, boxes, conduits, power packs, control units, shields/ masks, etc., for a complete working system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install on wall when ceiling is complete.
- C. Location shall be checked for items that would conflict with beam spread. Provide masking as per manufacturer specifications and recommendations along glass walls to prevent nuisance activation.
- D. Occupancy sensor power packs shall be located above accessible ceiling or in drywall ceiling conditions occupancy sensor power packs shall be installed in local storage rooms or janitors closets.
- E. Maintain at least 4' from air devices (or more as specified by manufacturer.)
- F. All line voltage devices shall have a neutral pulled to the device.

3.2 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to control device manufacturer's written instructions, unless otherwise indicated.

- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260010.
- B. Identify controlled circuits in lighting control units.
- C. Identify circuits or luminaries controlled by occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays, sensitivity, light levels, etc.
- B. Control devices that fail tests and inspections are defective work.

3.5 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements in other Division 26 Sections.

END OF SECTION 260938

SECTION 260940 – COMMISSIONING OF ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. The purpose of this Section is to define Contractor responsibilities in the commissioning process, which are being directed by the Contractor. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, "Recommended Practice for Commissioning Building Electrical Systems", 27th Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. Division 26 shall be familiar with all parts of the Commissioning Plan and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. Electrical systems to be commissioned include the following:
 - 1. Generator.
 - 2. Lighting Controls.
- D. The Electrical Contractor shall also participate in the commissioning process per specification section:
 - 1. 220940 - Commissioning of Plumbing Systems
 - 2. 230940 - Commissioning of Mechanical Systems

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards.

1.4 DEFINITIONS

- A. Commissioning: A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Contract Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and that Contractor has provided Owner adequate system documentation and training.
- B. Commissioning Authority (CxA): The Professional, appointed by the Owner, to direct and coordinate the commissioning process.
- C. Commissioning Plan: Document that provides the structure, schedule, and coordination plan for the Commissioning process from the construction phase through the warranty period. The Commissioning Plan must satisfy the Owner's test requirements.
- D. Commissioning Team: Working group made up of representative(s) from the Architect/Engineer (AE), the CxA, Contractor, Owner's Test, Adjust, and Balance (TAB) Firm, Building Automation System (BAS) provider, specialty manufacturers and suppliers, and Owner. Contractor will provide ad-hoc representation of Subcontractors on the Commissioning Team as required for implementation of the Commissioning Plan.
- E. Deferred Tests: 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.
- F. Deficiency: Condition of a component, piece of equipment or system that is not in compliance with Contract Documents.
- G. Factory Testing: Testing of equipment at the factory, by factory personnel with an Owner's representative present if deemed necessary by Owner.
- H. Functional Performance Test Procedures: Commissioning protocols and 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. Contractor prepares these procedures to document Functional Performance Tests.
- I. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by Contractor. Systems are tested under various modes, such as high loads, component failures, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Functional Performance Tests are executed after start-ups and Prefunctional Checklists are complete.
- J. Integrated System Test: Test of dynamic function and operation of multiple systems. Integrated System 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. Components are verified to be responding in accordance with Contract Documents. Integrated System Tests are executed after Functional Performance Tests are complete and prior to Substantial Completion. Integrated System Tests provide verification that the integrated systems will properly function according to the Contract Documents.

- K. Integrated System Test 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. Contractor prepares these procedures to document Integrated System Tests.
- L. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., labels affixed, sensors/meters calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer's Start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-up/Functional Performance Test Form.
- M. Start-up: The activities where equipment is initially energized, tested, and operated. Start-up is completed prior to Functional Performance Tests.
- N. Test Requirements: Requirements specifying what systems, modes and functions, etc. must be tested. Test requirements are not detailed test procedures. Test requirements and acceptance criteria are specified in the Contract Documents.

1.5 SUBMITTALS

- A. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the CxA for review and approval.
- B. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Factory Test Reports, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- C. Contractor shall submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- D. Contractor shall review and approve other relative documentation for impact on FPT's of the systems:
 - 1. Shop Drawings and product submittal data related to systems or equipment to be commissioned. The Subcontractor responsible for the FPT shall review and incorporate comments from the Owner and AE via the Contractor.
 - 2. Incorporate manufacturer's Start-up procedures with Prefunctional checklists.
 - 3. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPT's.
 - 4. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.
 - 5. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements: To validate adequacy and completeness of the FPT, the Contractor shall ensure that the O&M manual content, marked-up record

Drawings and Specifications, component submittal drawings, and other pertinent documents are available at the Project Site for review.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 TEST EQUIPMENT

- A. Provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Construction Phase:
 - 1. Include the following requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
 - 2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings to facilitate the Commissioning process.
 - 3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
 - 4. Provide additional requested documentation, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.
 - a. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
 - b. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted.
 - c. This information and data request may be made prior to normal submittals.
 - 5. With input from the BAS Provider, the Owner and AE, clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.

6. Develop the Commissioning Plan, in cooperation with the CxA, using manufacturer's Start-up procedures and the Prefunctional Checklists. Submit manufacturer's detailed Start-up procedures and the Commissioning Plan and procedures and other requested equipment documentation to Owner for review.
7. Prepare the specific Functional Performance Test procedures specified in Section 26 08 16. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
8. During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.
9. Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.
10. Address current AE and Owner punch list items before Functional Performance Tests.
11. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager, the CxA and AE and retest the system and equipment.
13. Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.
14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
15. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The as-built drawings and specifications shall be delivered to the Owner both in electronic format and hard copies as required by the Owner.
16. Provide training of the Owner's operating personnel as specified.
17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Warranty Phase:

1. Execute seasonal or deferred tests, witnessed by the Owner, according to the Specifications.
 - a. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.
 - b. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.

2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any seasonal testing.

3.2 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 installation shall be in accordance with manufacturer's published recommendations.

3.3 TESTING

- A. Prefunctional Checklists and Start-up:
 1. Follow the Start-up and initial checkout procedures listed in this Section. Start-up and complete systems and sub-systems so they are fully functional, meeting the requirements of the Contract Documents.
 2. Prefunctional Checklists shall be complete prior to commencement of a Functional Performance test.
- B. Functional Performance Tests:
 1. Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed.
- C. Coordination Between Testing Parties:
 1. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.

3.4 TRAINING

- A. Submit a written training plan to the Owner, CxA and Architect/Engineer for review and approval. Contractor's training plan shall cover the following elements:
 1. Equipment included in training: Generator and Lighting Controls.
 2. Intended audience.
 3. Location of training.
 4. Objectives.
 5. Subjects covered.
 6. Duration of training on each subject.
 7. Instructor for each subject.
 8. Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written handouts, etc.).
 9. Instructors and qualifications.

- B. Contractor shall have the following training responsibilities:
1. Provide a training plan fourteen(14) calendar days prior to the scheduled training, in accordance with Division 01.
 2. Provide Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned equipment or system.
 3. Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including Start-up, shutdown, fire/smoke alarm, power failure, etc.
 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This representative may be the Start-up technician for the piece of equipment, the installing contractor, or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 6. The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.
 7. Training shall include:
 - a. Usage of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include Start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanation of information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 8. Hands-on training shall include Start-up, operation in all modes possible, including manual, shutdown, and any emergency procedures and maintenance of all pieces of equipment
 9. Training shall occur after Functional Performance Tests are complete and shall be scheduled with the Owner's Project Manager.
 10. Provide training on each system/piece of equipment as specified in other sections.

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END OF SECTION 260940

SECTION 260941 – ACCESS CONTROL SYSTEM**PART 1 - GENERAL**

- 1.1 The intent of this document is to specify the minimum criteria for the design, and installation of a physical access control system (SYSTEM).
- 1.2 One of the SYSTEM's primary purposes shall be to provide access control. The SYSTEM shall be able to make access granted or denied decisions, define access levels, and set time zones and holidays. An input/output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The SYSTEM shall support features such as area control, database segmentation, and time zone/holiday overrides.
- 1.3 The SYSTEM shall have an open architecture design. It shall be a true open architecture design and support industry standards for databases, networks, credential printers, and video cameras. No customized or proprietary PC or credential creation software or hardware shall be required to operate the SYSTEM. The SYSTEM shall be both scalable and portable to give CUSTOMER the ability to increase performance based on CUSTOMER requirements. This shall give CUSTOMER maximum flexibility and room for unlimited growth.
- 1.4 SCOPE OF WORK
 - A. The scope of work for this project includes:
 1. Design and input of system database (training structure only-no data entry.)
 2. Intelligent System Control panels (ISC's)
 3. "I" Class Smart Card readers.
 4. Electric door locks and door lock power supplies shall operate on 24 volts as specified under Door Hardware, provided by others and installed by the electrical contractor.
 5. Provide interface to the building fire alarm system for release of locks in a fire condition.
- 1.5 REFERENCES
 - A. Federal Communications Commission (FCC):
 1. FCC Part 15 - Radio Frequency Devices
 - B. Underwriters Laboratories (UL):
 1. UL294 - Access Control System Units
 - C. National Fire Protection Association (NFPA):
 1. NFPA70 - National Electrical Code
- 1.6 SUBSTITUTIONS
 - A. The specified system is an integrated system from Lenel consisting of various manufacturers' products as specified. The specified equipment is compatible as an integrated system and any substitution may not provide for a working system. It is the responsibility of the contractor to provide a complete working system.

- B. Substitutions are permitted if the equipment supplier provides manufacturer verified technical data confirming system compatibility to the engineer. Equipment manufacturers that may be substituted include Avigilon, Genetec, Honeywell and Mercury. It is the responsibility of the contractor to provide a complete working system.

PART 2 - PRODUCTS

2.1 SYSTEM OVERVIEW

- A. The system shall provide a number of functions including the ability to regulate access through specific doors to secured areas of the facility. The SYSTEM's operating environment shall be the fully multi-tasking multi-threading Microsoft Windows 11 Operating System. The SYSTEM's web enabled client applications shall be capable of running on independent client operating systems including Windows, Macintosh, UNIX, Linux, and Solaris.
- B. The system shall allow the configuration of enrollment & badging functions, alarm monitoring and administrative functions on a single workstation. The system shall be expandable to support an unlimited number of individual module or integrated client workstations. All access control field hardware, including Intelligent System Controllers (ISCs), shall be connected to every / any Windows based access control system workstation on the network. Provide one PC workstation under this contract including 22-inch flat panel monitor and report printer.

- 2.2 All system data must reside on a single database and must be accessible in real time to every / any system workstation connected to the network if the owner wishes to network this system. This shall allow for automatic change propagation to all client workstations on the system as well as a common database to consolidate all information and allow for better disaster recovery.

- A. The SYSTEM must be designed to perform a wide variety of feature rich functions. These SYSTEM functions are categorized into nineteen primary "system modules" which shall include:

1. Access Control
2. Alarm Monitoring
3. Credential Management
4. Digital Video Management
5. Intrusion Detection Management
6. Asset Management
7. Visitor Management
8. Remote Access Level Management
9. Third Party Interfaces
10. System Administration
11. Mobile Enterprise Solutions
12. Badge Layout Creation
13. Screen/Forms Creation
14. Graphical Map Creation
15. Application Programming Interfaces
16. Data Import
17. Bi-Directional Data Exchange

- 18. API Development Toolkit
- 19. Server Redundancy
- B. Provide access control only as part of this contract.
- 2.3 The system shall be designed to support any industry standard network topology including those listed below.
 - A. TCP/IP
 - B. Novell Netware (IPX/SPX)
 - C. Digital PATHWORKS
 - D. Banyan VINES
 - E. IBM LAN Server (NetBUI)
 - F. IBM SNA Networks
 - G. Microsoft LAN Manager (NerBUI)
 - H. NFS Networks
 - I. Remote Access Service (RAS) via ISDN, x.25 and standard phone lines
- 2.4 OPERATING SYSTEM
 - A. The system shall support the 64-bit Microsoft Windows 11 multi-tasking, multi-threading operating system. The system must meet the below requirements for a Windows 11 based system.
 - B. Interface:
 - 1. The operating system shall offer the look and feel of Windows 11 to enhance usability and efficiency. The operating system shall come complete with administrative wizards and interactive help to guide System Administrators in the configuration of the system.
 - C. Networking
 - 1. The operating system shall support a minimum of 15 networking protocols including, but not limited to, TCP/IP, IPX/SPX, RAS, and NetBUI. The system shall also support peer-to-peer and FTP server capabilities.
 - D. Remote Management
 - 1. The operating system shall utilize remote management utilities such as event viewers and performance monitors to fine tune and optimize the operating system that will in turn optimize the system. It shall support both dial out capabilities to remote servers as well as remote dial in capabilities.
 - E. Remote Access Services (RAS)
 - 1. The operating system shall support full remote diagnostics abilities through its remote access services. Full network functionality shall be available over remote links using NetBUI, IPX/SPX, and TCP/IP protocols. Dial in capability to remote Windows 11 Servers using remote access service shall also be available.
 - F. Security

1. The operating system shall support multiple user profiles on the same client workstation so System Administrators can assign which programs shall be available to System Operators based on their operating system user log-on. Local desktop security shall be available through User ID and required password log-on.
2. The system shall support industry standard Open Database Connectivity (ODBC) compliant relational database management systems. This shall include relational database management systems such as Microsoft SQL Server 2025.

G. Graphical User Interface

1. The system shall have an easy to use Windows Graphical User Interface. It shall be intuitive and all messages and commands shall be in English Prose. All functions shall be both keyboard and mouse driven.

H. Migration & Upgrades

1. The system shall support a seamless upward and horizontal migration path from system to system. The system shall ship with the ability to support the largest system in the product line complete with all the modules, features and functionality described above and below. The system size and feature set shall be controlled by a software / hardware license key and shall be programmed based on licensing.

I. Seamless Integration

1. All system application modules, features, and functions must be generated from a single source code set. The access control, alarm monitoring, asset management, remote access level management, and visitor management, and ID management modules of the software shall be created from this single source code set. There absolutely shall not be separate source code bases for different modules. Thus, a single manufacturer must develop all modules of software. All system modules shall be seamlessly integrated to feature a single system, single code base, single graphical user interface, and single database.

2.5 FUNCTIONAL AND OPERATIONAL REQUIREMENTS

A. General

1. The design of the system shall include devices and equipment to monitor and control access of cardholders to restricted areas, detect and deny unauthorized attempted entries within specific buildings or areas annunciate alarms and generate reports. Once incorporated with the daily operations of the designated facility, the system shall detect and deny unauthorized entry into restricted areas, while granting entry to individuals who have proper access rights. The system is to be designed and configured to provide operational flexibility, reliable performance, and ease of use.

B. Operational Concept

1. The system shall consist of equipment and devices placed at predetermined locations to ensure that only cardholders that are authorized to enter secured areas through certain

doors can do so. This shall be accomplished by means of a computer(s) and electronic devices used in conjunction with door locks and card readers.

2. Photo badges are a capability of the system but not part of this contract. The badging may be added to the system at a later date.
3. When a new cardholder presents himself/herself to the Enrollment Operator an informational form shall be available on the system. This data screen shall contain at a minimum 20 data entry fields of information that will include, but not be limited to, the following:
 - a. Last Name
 - b. First Name
 - c. Middle Initial
 - d. Social Security #
 - e. Badge Type
 - f. Address
 - g. City
 - h. State
 - i. Zip Code
 - j. Phone #
 - k. Birth Date
 - l. Title
 - m. Department
 - n. Division
 - o. Location
 - p. Building
 - q. Floor
 - r. Office Phone #
 - s. Extension
 - t. Signature
 - u. Last Reader Accessed
 - v. Record Last Changed
 - w. Badge ID
 - x. Issue Code
 - y. Number of Prints
 - z. Activation Date
 - aa. Deactivation Date/Time
 - bb. Badge Status
 - cc. PIN Number
 - dd. Embossed Number
 - ee. Date of Last Badge
 - ff. Photo
 - gg. Photo Display
4. The data screen shall allow for a minimum of sixteen pages of cardholder information that shall be input upon enrollment. Above and beyond the fixed fields such as Last Name, First Name, there shall also be user-definable fields of which the system can designate, if desired, as drop-down menus to ensure data integrity. These fields shall

vary in character length as dictated by the System Administrator. Data fields shall be assigned as alphanumeric, numeric, date, or unique. Numeric, date, and unique fields shall be generated by the system if desired.

5. System Capacities

- a. The system shall support an unlimited number of card readers, input point, and relay outputs. The system database server shall support an unlimited number of cardholders, visitors, and assets limited only by the memory located in the Intelligent System Controllers in which cardholder information will be downloaded. The database server shall also support an unlimited number of access events and System Operator transactions in the history file. The system shall support an unlimited number of client workstations, so long as the network supports them. A fully loaded system shall guarantee a one half-second response time for access granted/denied decisions from the time that a cardholder swipes his/her card.

6. System Features and Requirements

- a. All system applications must be easy to use and attractive to look at. The system shall utilize a user friendly Windows Graphical User Interface. It shall utilize keyboard and mouse operations with graphical presentations of screen information. System Operators / System Administrators shall change the look and feel of the applications by setting the typeface and size of font for the way they wish for the system information to be displayed. A minimum of 255 typeface combinations shall be available for System Operators to choose from. Each application shall provide a consistent user interface across all operations of the system. All routine information displayed and requiring input must be in English language prose.

2.6 ACCESS CONTROL

A. Time Zones

1. The system must be capable of creating and storing up to two hundred fifty five (255) time zones. Each time zone must have a minimum of six (6) intervals. Each interval shall be assignable to any day of the week and capable of being restricted on a minimum of eight (8) types of holidays.

B. Access Levels

1. All cardholders shall have access based on facility, card reader, time, and day. The card readers must grant access to cardholders assigned to the appropriate access levels. The capability to define a minimum of 32,000 access levels is required to provide the System Administrator flexibility in assigning access privileges to cardholders. A minimum of thirty-two (32) access levels shall be assignable to each cardholder.

C. Temporary Access Levels

1. Inclusive of the above 32,000 Access Levels, the system shall allow the System Administrator to define Temporary Access Levels that combine card readers and time zones.

D. Access Groups

1. The system shall allow System Administrators to define an unlimited number of access groups.

E. Precision Access Levels

1. The system shall include the ability to utilize Precision Access Levels above and beyond the aforementioned 32,000 standard and temporary access levels. This will offer the ability to assign "unlimited card reader/time zone combinations."

F. Holidays

1. The system must allow the System Administrator to designate certain dates as holidays. As well, the dates for Daylight Savings Time shall be definable and shall automatically take effect without user intervention. The system shall support a minimum of 255 Holiday assignments.

G. Database Segmentation

1. The system shall employ advanced database segmentation functionality. Each segment shall be allowed to have its own unique set of hardware and system parameters including access control field hardware, time zones, access levels, etc., which shall allow System Administrators to expand upon current hardware constraints. For example, each segment shall have its own 32,000 access levels, 255 time zones, and 255 holidays. As such, only ID cards that are assigned access levels to card readers in a segment need to be downloaded to the Intelligent System Controllers in that segment.

2.7 FIELD HARDWARE COMMUNICATIONS

- A. The system shall communicate with the Intelligent System Controllers (ISC) by RS-485 EIA standard. The system shall have the ability to communicate with ISCs by LAN/WAN connections utilizing TCP/IP communications protocol. The system shall also have the ability to communicate with the ISCs through remote dial up capabilities. The ISC shall be Lenel model LNL-500 with the following features.

1. Multi-Drop Panel Support
2. Extended Individual Strike Times
3. Extended Individual Door Held Open Times
4. Elevator Control
5. Graphical System Overview Tree
6. Pre-Alarm
7. Alarm/Event Logging
8. Multiple Card Formats
9. On-Line Contact Sensitive Help
10. Monitor Zones

11. Alarm/Event Routing
 12. Text Instructions
 13. Customizable Voice Instructions
 14. Customizable Voice Annunciation
 15. Alarm Attributes
 16. Alarm-Event Mappings
 17. System Downloads
- 2.8 Access Control Field Panels - The security management system shall be equipped with access control field panels required to receive alarms and administer all access granted/denied decisions. All field panels shall meet UL requirements. The system shall include the following components:
- A. Reader Interface Module (DRI-dual reader interface): The DRI shall provide an interface between the Intelligent System Controller (ISC) and the card readers. The DRI shall operate with any card reader that produces a standard Open Supervised Device Protocol (OSDP) communication output. The dual reader interface module shall be the Lenel model LNL-1320 provided as required by readers shown on the drawings with the following features.
 1. Up to 32 devices shall be configured per ISC.
 2. Each DRI shall include two (8) relay inputs and two (6) relay outputs.
 3. Up to 8 unique card formats shall be supported per card reader.
 4. Input power shall be 12VDC.
 - B. Power supplies shall be provided as required for all reader interface modules and door locks. The system power supplies shall be 4 amp model LNL-AL600ULX-4CB6 UL Listed assemblies mounted in Lenel system enclosures to include door control modules. The actual locks and lock power are to be provided by the others and specified elsewhere.
 - C. "I" Class contactless card readers shall be provided at the specified locations. Coordinate with architectural door hardware specs and schedule. The card readers shall be HID 6100CGN0000L utilizing "I" Class Smart Card Technology and shall include the following features.
 1. "I" Class Smart Card readers.
 - a. Power: The reader shall be powered by external 12VDC or by the controller's internal 12VDC regulated power supply.
 - b. Mounting: The reader shall be capable of being mounted against metal door or window frames.
 - c. Range: The reader shall be capable of reading cards at a range of two to four inches.
 - d. Electronics: The reader electronics shall be encapsulated for environmental security.
 - D. Provide 50 compatible "I" class key fobs with the system. Key fobs shall be HID model 2051NKNNN. Provide an additional 50 "I" Class Smart Cards HID model 2080PGSNV.
 - E. Gate control shall be accomplished via an HID 6150AKT0000L Long Range Smart Card Reader installed at the gate to allow key fobs or smart cards to activate the parking gate.

2.9 ASSOCIATED EQUIPMENT

- A. Magnetic Door Contacts shall be Sentrol 1076CW-N for recessed flush mounted applications. Finish as selected by the Architect. Provide with steel door adapter when required. The devices shall have a two pole contact, one for the access control system and one for the intrusion detection system. Overhead doors shall be Honeywell 959 for surface mounted application with aluminum housing and adjustable L bracket magnet with armored cable lead.
- B. Request to exit motion detectors shall be Detection System DS-160 (where applicable). Finish as selected by the Architect.
- C. Door strikes and power supplies shall be provided by others. Power shall be provided under this contract and be 120 volts brought to a location above the door.
- D. Coordinate all equipment and devices to be compatible with door hardware specified under Division 8.
- E. Cabling shall be plenum rated of types and sizes recommended by the manufacturer.

2.10 Surge Protection Devices

- A. Where metallic cabling leaves the building above or below grade to an exterior device, provide surge protection where the cabling exits the building. Where devices are mounted to an exterior wall and cabling does not extend past the building façade, surge protection may be omitted. Surge device shall be equivalent to Ditek.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. The Access Control, Alarm Monitoring shall be installed in accordance with the manufacturer's installation instructions.
- B. Install boxes, conduits, cables, conductors, equipment, devices and provisions as required for a complete and operable system.
- C. Raceways shall be run concealed in walls, doorframes and above inaccessible ceilings.

3.2 TESTING AND CERTIFICATIONS

- A. The Access Control, Alarm Monitoring system shall be tested in accordance with the following:
 - 1. The equipment supplier shall conduct a complete inspection and test of all installed access control and security monitoring equipment.
 - 2. All deficiencies noted in the above test shall be corrected.
- B. A letter of certification shall be provided to indicate that the tests have been performed and all devices are operational.

3.3 SUBMITTALS

- A. General: Submittals shall be made in accordance with the Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Shop Drawings and Schematics: The following items shall be provided:
 - 1. Connection diagrams for all interfacing equipment including power requirements.
 - 2. List of all provided equipment.
 - 3. Locations for all major equipment components installed under this specification.
- C. Product Data: The following shall be provided:
 - 1. Technical data sheets.
 - 2. A complete set of user guides, installation manuals, and operation manuals on all new equipment.
- D. Quality Assurance
 - 1. Checkout report: The Contractor shall provide the owner with a checkout report for each piece of equipment. The report shall include:
 - a. Complete list of each device
 - b. The date it was tested and by whom
 - c. The date it was re-tested and by whom (if required)
 - d. Final test report indicating that every device was tested successfully.
 - 2. Manufacturer's instructions: The Contractor shall deliver a set of System Operation and Maintenance manuals to the Owner.
 - 3. All devices shall be UL Compliant.
- E. CERTIFICATION
 - 1. The equipment supplier/firm must be an authorized, trained equipment supplier with minimum of 5 years of selling, installing and maintaining similar systems and services as outlined in this document. The firm shall have an established office located within 100 miles of the jobsite and be capable of providing 4-hour response time for emergencies related to the system.
 - 2. All technicians providing final wire termination, configuration and programming on major components shall be manufacturer trained on the products being installed under this scope, certifications shall be provided within submittals.

3.4 WARRANTY

- A. General: The warranty period shall be for a one (1) year period commencing with the delivery of equipment or date of first beneficial use by the end user.

3.5 TRAINING

- A. Operator training of the system shall be conducted at the customer's site. Provide 6 hours of user administration and/or alarm monitoring training as specified.

- B. Training shall be performed by manufacturer certified factory-trained personnel.

END OF SECTION 260941