

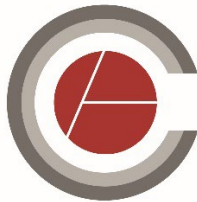


Laredo College Veterans Services Center Project

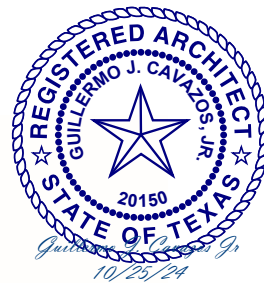
Laredo College Fort McIntosh Campus
West End Washington St., Laredo, Texas 78040

Laredo College
West End Washington Street
Laredo, 78040

Architects Project #23-15
October 25, 2024



CAVAZOS ARCHITECTS



**SECTION 00 01 10
TABLE OF CONTENTS**

PROCUREMENT AND CONTRACTING REQUIREMENTS

1.01 DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

- A. 00 01 01 - Project Title Page
- B. 00 01 10 - Table of Contents
- C. 00 01 15 - List of Drawing Sheets
- D. Geotechnical Engineering Study by Castle Engineering

SPECIFICATIONS

2.01 DIVISION 01 -- GENERAL REQUIREMENTS

- A. 01 10 00 - Summary
- B. 01 21 00 - Allowances
- C. 01 25 00 - Substitution Procedures
- D. 01 30 00 - Administrative Requirements
- E. 01 40 00 - Quality Requirements
- F. 01 42 16 - Definitions
- G. 01 42 19 - Reference Standards
- H. 01 50 00 - Temporary Facilities and Controls
- I. 01 60 00 - Product Requirements
- J. 01 70 00 - Execution and Closeout Requirements
- K. 01 78 00 - Closeout Submittals

2.02 DIVISION 02 -- EXISTING CONDITIONS

- A. 02 41 00 - Demolition

2.03 DIVISION 03 -- CONCRETE

- A. 03 30 00 - Cast-in-Place Concrete

2.04 DIVISION 04 -- MASONRY

- A. 04 23 00 - Reinforced Unit Masonry
- B. 04 53 13 - Masonry Repair and Restoration

2.05 DIVISION 05 -- METALS

- A. 05 40 00 - Cold-Formed Metal Framing
- B. 05 50 00 - Metal Fabrications

2.06 DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

- A. 06 10 00 - Rough Carpentry
- B. 06 19 20 - Prefabricated Wood Trusses
- C. 06 41 00 - Architectural Wood Casework

2.07 DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

- A. 07 21 00 - Rigid Board Insulation (Walls)
- B. 07 21 13 - Continuous Insulation (Roofs)
- C. 07 27 26.01 - Fluid-Applied Membrane Air Barrier
- D. 07 30 11 - Roofing Underlayment, High Temperature

- E. 07 41 13 - Metal Roof Panels
- F. 07 62 00 - Sheet Metal Flashing and Trim
- G. 07 92 00 - Joint Sealants
- H. 07 95 13 - Expansion Joint Cover Assemblies

2.08 DIVISION 08 -- OPENINGS

- A. 08 11 13 - Hollow Metal Doors and Frames
- B. 08 12 13 - Hollow Metal Frames
- C. 08 14 16 - Flush Wood Doors
- D. 08 41 13.22 - Aluminum Framed Entrances & Storefronts
- E. 08 51 13 - Aluminum Windows

2.09 DIVISION 09 -- FINISHES

- A. 09 21 16 - Gypsum Board Assemblies - USG
- B. 09 24 00 - Cement Plastering
- C. 09 30 00 - Tiling
- D. 09 51 13 - Acoustical Ceilings
- E. 09 51 15 - Acoustical Ceilings - Calla
- F. 09 51 26 - Wood-Veneered Ceiling Panels
- G. 09 65 13 - Resilient Wall Base
- H. 09 81 16 - Acoustical Blanket Insulation
- I. 09 84 00 - Tectum Direct Attach Panels
- J. 09 90 00 - Painting and Coating - Commercial Facility Guide Specification - Sherwin-Williams

2.10 DIVISION 10 -- SPECIALTIES

- A. 10 14 19 - Dimensional Letter Signage
- B. 10 14 23 - Panel Signage
- C. 10 28 00 - Toilet, Bath, and Laundry Accessories - ASI
- D. 10 44 00 - Fire Protection Specialties

2.11 DIVISION 11 -- EQUIPMENT

2.12 DIVISION 12 -- FURNISHINGS

- A. 12 21 13 - Horizontal Louver Blinds

2.13 DIVISION 13 -- SPECIAL CONSTRUCTION

2.14 DIVISION 14 -- CONVEYING EQUIPMENT

2.15 DIVISION 21 -- FIRE SUPPRESSION

2.16 DIVISION 22 -- PLUMBING

- A. 22 00 00 SUMMARY OF PLUMBING WORK
- B. 22 05 00 COMMON WORK RESULTS FOR PLUMBING
- C. 22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
- D. 22 05 53 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
- E. 22 07 19 PLUMBING PIPING INSULATION
- F. 22 11 16 DOMESTIC WATER PIPING

- G. 22 11 19 DOMESTIC WATER PIPING SPECIALTIES
- H. 22 13 13 FACILITY SANITARY SEWERS
- I. 22 13 19 SANITARY WASTE PIPING SPECIALTIES
- J. 22 33 00 ELECTRIC DOMESTIC WATER HEATERS
- K. 22 42 00 COMMERCIAL PLUMBING FIXTURES
- L. 22 47 13 DRINKING FOUNTAINS

2.17 DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

- A. 23 00 00 HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)
- B. 23 05 00 COMMON WORK RESULTS FOR HVAC
- C. 23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
- D. 23 05 63 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
- E. 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC
- F. 23 07 13 DUCT INSULATION
- G. 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- H. 23 23 00 REFRIGERANT PIPING
- I. 23 26 00 CONDENSATE DRAIN PIPING
- J. 23 31 13 METAL DUCTS
- K. 23 33 00 HVAC DUCT ACCESSORIES
- L. 23 33 46 FLEXIBLE DUCTS
- M. 23 34 16 CENTRIFUGAL HVAC FANS
- N. 23 37 13 DIFFUSERS, REGISTERS AND GRILLES
- O. 23 73 12 DX AIR-HANDLING UNITS, SINGLE ZONE VAV

2.18 DIVISION 25 -- INTEGRATED AUTOMATION

2.19 DIVISION 26 -- ELECTRICAL

- A. 26 00 00 ELECTRICAL
- B. 26 00 01 ELECTRICAL GENERAL REQUIREMENTS
- C. 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
- D. 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- E. 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- F. 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- G. 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
- H. 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
- I. 26 05 73.13 SHORT CIRCUIT STUDIES
- J. 26 05 73.19 ARC-FLASH HAZARD ANALYSIS
- K. 26 09 23 LIGHTING CONTROL SYSTEM
- L. 26 24 16 PANELBOARDS
- M. 26 27 26 WIRING DEVICES
- N. 26 28 13 FUSES
- O. 26 28 16.16 ENCLOSED SWITCHES

- P. 26 43 13 SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
- Q. 26 51 00 INTERIOR LIGHTING
- R. 26 56 00 EXTERIOR LIGHTING

2.20 DIVISION 27 -- COMMUNICATIONS

- A. 27 05 33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS
- B. 27 10 00 - Structured Cabling

2.21 DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

- A. 28 13 00 - Access Control System
- B. 28 16 00 - Intrusion Detection
- C. 28 23 00 - Video Surveillance System

2.22 DIVISION 31 -- EARTHWORK

2.23 DIVISION 32 -- EXTERIOR IMPROVEMENTS

2.24 DIVISION 33 -- UTILITIES

2.25 DIVISION 34 -- TRANSPORTATION

2.26 DIVISION 40 -- PROCESS INTEGRATION

2.27 DIVISION 46 -- WATER AND WASTEWATER EQUIPMENT

END OF SECTION 00 01 10

SECTION 00 01 15
LIST OF DRAWING SHEETS

G-000	TITLE SHEET
G-001	DRAWING INDEX & CONVENTIONS
G-002	ACCESSIBILITY STANDARDS
G-003	ACCESSIBILITY STANDARDS
G-004	ACCESSIBILITY STANDARDS
G-005	ACCESSIBILITY STANDARDS
G-006	TAS FLOOR PLAN
LS-1.0	LIFE SAFETY PLAN
C-1	GENERAL NOTES & CONTROL POINTS PLAN
C-2	EXISTING SITE PLAN
C-3	DEMOLITION PLAN
C-4	PROPOSED SITE & DIMENSIONAL PLAN
C-5	GRADING PLAN
C-6	UTILITIES SYSTEMS PLAN
C-7	STORM WATER POLLUTION PREVENTION PLAN
C-8	GENERAL DETAILS
AEX-100	EXISTING SITE PLAN
AEX-101	EXISTING FLOOR PLANS
AEX-102	EXISTING ELEVATIONS
AEX-103	EXISTING CONDITIONS EXTERIOR PHOTOS
AEX-104	EXISTING CONDITIONS INTERIOR PHOTOS
AEX-105	EXISTING SECTIONS
AD-101	SITE PLAN DEMOLITION
AD-102	DEMOLITION FLOOR PLAN
AD-103	DEMOLITION ROOF & ELEVATIONS
A-001	SITE PLAN
A-002	ENLARGED SITE PLANS
A-003	SITE DETAILS
A-005	LANDSCAPE PLAN
A-101	1st FLOOR PLAN
A-103	1st FLOOR EQUIPMENT & SIGNS PLAN
A-110	ROOF PLAN
A-120	1st FLOOR RCP
A-201	BUILDING ELEVATIONS
A-202	BUILDING ELEVATIONS
A-301	BUILDING SECTIONS
A-302	BUILDING SECTIONS
A-303	BUILDING SECTIONS
A-401	ENLARGED PLANS
A-420	RR PLANS & ELEVATIONS
A-430	WALL SECTIONS

A-431	WALL SECTIONS
A-501	PLAN DETAILS
A-601	ROOM FINISH SCHEDULE
A-610	WALL TYPES
A-620	DOOR SCHEDULES
A-630	WINDOWS SCHEDULES
A-701	MILLWORK ELEVS & DETAILS
R-301	MASONRY AND WINDOW DETAILS
R-302	ROOF DETAILS
R-303	ROOF DETAILS
MG-101	MECHANICAL NOTES & LEGENDS
MP-101	MECHANICAL FLOOR PLAN
MS-101	MECHANICAL SCHEDULES
MC-101	MECHANICAL CONTROLS
MC-102	MECHANICAL CONTROLS
MD-101	MECHANICAL DETAILS
EG-101	ELECTRICAL LEGEND
ES-101	ELECTRICAL SITE LIGHTING PLAN
EDP-101	ELECTRICAL DEMOLITION PLAN
EL-101	ELECTRICAL LIGHTING FLOOR PLAN
EP-101	ELECTRICAL POWER FLOOR PLAN
ER-101	ELECTRICAL RISER DIAGRAM
ED-101	ELECTRICAL DETAILS
PG-101	PLUMBING LEGEND
P-100	PLUMBING DEMOLITION
P-101	PLUMBING SEWER & VENT FLOOR PLAN
P-201	PLUMBING DOMESTIC WATER FLOOR PLAN
PD-101	PLUMBING DETAILS
T000	TECHNOLOGY SYMBOLS & LEGEND
T001	TECHNOLOGY STE PLAN
T002	TECHNOLOGY DEMO FLOOR PLAN
T101	TECHNOLOGY 1st FLOOR PLAN
T301	TECHNOLOGY ENLARGED VIEWS
T401	TECHNOLOGY TYPICAL DETAILS
T402	TECHNOLOGY TYPICAL DETAILS
TA000	AUDIOVISUAL SYMBOLS & LEGEND
TA101	AUDIOVISUAL 1st FLOOR PLAN
TA601	AUDIOVISUAL TYPICAL DETAILS
TS000	SECURITY SYMBOLS & LEGEND
TS001	SECURITY PLAN
TS100	SECURITY DEMO FLOOR PLAN
TS101	SECURITY 1st FLOOR PLAN
TS401	SECURITY TYPICAL DETAILS

TS501

SECURITY SCHEDULES

END OF SECTION 00 01 15

This page intentionally left blank

GEOTECHNICAL ENGINEERING STUDY

Laredo College Veterans Center
Fort McIntosh Campus
West End Washington Street
Laredo, Webb County, Texas

CONDUCTED FOR:

**Cavazos
Architects**



2024

PREPARED BY:



3302 CUATRO VIENTOS DRIVE, SUITE NO. 12

LAREDO, TEXAS 78046

TBPE REGISTRATION No. F-10341



September 12, 2024

Mr. Guillermo J. Cavazos, Jr., AIA, LEED AP
Principal Architect
Cavazos Architects
9114 McPherson Road, Suite 305
Laredo, Texas 78045



**Re: Geotechnical Engineering Report
Laredo College Veterans Center
Fort McIntosh Campus
West End Washington Street
Laredo, Texas 78040
CET Project No.: 24G034**

Dear Mr. Cavazos, Jr.:

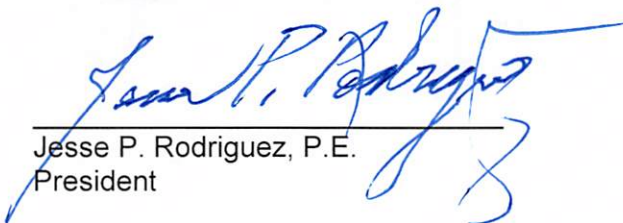
Castle Engineering & Testing, LLC. (CET) is pleased to submit the enclosed Geotechnical Engineering Report for the proposed referenced project.

We appreciate the opportunity to assist in this phase of the project, and we look forward to providing construction materials testing and observation services as the project progresses.

Should you have any questions concerning our findings or if you desire additional information, please do not hesitate to call our office.

Respectfully,

Castle Engineering & Testing, LLC



Jesse P. Rodriguez, P.E.
President



Copies Submitted: One (1) Cavazos Architects; Mr. Guillermo J. Cavazos, Jr., AIA, LEED AP

CONTENTS

1. INTRODUCTION..... 1

1.1 Authorization and Scope 1

1.2 Project Description 1

2. FIELD AND LABORATORY TESTING..... 1

2.1 Field Testing 1

2.2 Laboratory Testing..... 2

3. SITE AND SUBSURFACE CONDITIONS..... 2

3.1 Site Conditions 2

3.2 Subsurface Conditions 2

3.3 Groundwater 3

4. EVALUATION..... 3

4.1 General..... 3

4.2 Potential Vertical Rise (PVR) 3

4.3 Bearing Capacity and Foundation Stability 4

5. RECOMMENDATIONS..... 4

5.1 Site Preparation..... 4

5.2 Foundation Discussion..... 5

5.3 Shallow Foundation Design..... 5

5.4 Vapor Retarder Membrane..... 7

5.5 Flatwork 7

6. OTHER CONSTRUCTION CONSIDERATIONS..... 8

6.1 Drainage..... 8

6.2 Landscapping 8

6.3 Utilities 8

7. GENERAL REMARKS..... 9

7.1 Construction Services 9

7.2 Limitations 9

APPENDIX

1. INTRODUCTION

1.1 Authorization and Scope

The geotechnical engineering study for the **Laredo College Veterans Center Project** was authorized by **Mr. Guillermo J. Cavazos, Jr., AIA, LEED AP, Principal Architect CAVAZOS ARCHITECTS**, through proposal G24051. The primary objective of this study was to ascertain and evaluate the stratification and engineering properties of the subsurface soils at the project site. Furthermore, the study aimed to develop engineering recommendations and guidelines to be utilized in site preparation, foundation design, pavement design, and other related site improvements.

1.2 Project Description

The proposed **Laredo College Veterans Center Project** is being developed based on the Site Data Plan provided by **CAVAZOS ARCHITECTS**. The final construction plans are currently under development, encompassing the proposed project and associated ancillary site improvements.

The project site is located at the **Fort McIntosh Campus** in Laredo, Texas.

2. FIELD AND LABORATORY TESTING

2.1 Field Testing

To evaluate the engineering characteristics of the subsurface materials, the project site was subjected to a comprehensive field investigation. The exploration involved drilling three (3) bore, one (1) bore to a depth of twenty-five (25) feet and two (2) bores to fifteen (15) feet. The key activities during the field investigation included:

- **Site Reconnaissance:** Initial survey and assessment of the project site to determine optimal locations for drilling.
- **Drilling of Borings:** Execution of three borings to retrieve soil samples and conduct in-situ testing.
- **Standard Penetration Tests (SPT):** Performed to determine the relative density and comparative consistency of the subsurface soils.
- **Sample Collection:**
 - **Disturbed Split-Barrel Samples:** Obtained in accordance with ASTM D-1586 (Penetration Test and Split-Barrel Sampling of Soils).
 - **Auger Samples:** Collected at selected intervals in the soil test borings.

The standard split-spoon sampler, a 2-inch O.D. tube, was driven into the soil to collect samples, which could then be split open lengthwise for easy removal and visual inspection. The results from the standard penetration tests provided crucial data on the relative strength and compressibility of the soil layers.

2.2 Laboratory Testing

Selected soil samples from the field investigation were subjected to a series of laboratory tests to determine their physical and mechanical properties. These tests included:

- **Atterberg Limits:** To classify the soils and assess their plasticity characteristics.
- **Moisture Content:** To determine the amount of water present in the soil samples.
- **Percent Fines:** To quantify the proportion of fine-grained particles in the soil.

These tests helped classify the soils and provided indicators of soil strength and behavior. All phases of the laboratory testing program were performed in accordance with the relevant ASTM Specifications, ensuring the accuracy and reliability of the data obtained for engineering analysis and recommendations.

A summary of the laboratory test results is presented in the Appendix. These results include detailed information on the physical and mechanical properties of the soil samples collected from the site, essential for evaluating the subsurface conditions and making informed engineering recommendations.

Sample Storage and Disposal:

- The collected soil samples will be stored for a period of 30 days from the date of the report issuance.
- If the client requires extended storage or specific disposal instructions, these must be provided in writing within this 30-day period.
- After 30 days, unless otherwise instructed, the samples will be disposed of accordingly.

3. SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

The project is located at the Fort McIntosh Campus in Laredo, Texas. The site is relatively flat.

3.2 Subsurface Conditions

The subsurface conditions encountered during the drilling operations are shown in the boring logs found in the Appendix. These subsurface exploration records represent an interpretation of subsurface conditions at the test locations and the soil conditions may vary at different locations.

Based on the field and laboratory data acquired during this study, the soils at the site are considered low-expansive materials and generally consisting of Clay (CL) and Clayey Sand (SC) and various combinations of clay and silt which extend to the depths drilled.

Table No. 1 - Major Strata

Stratum	Location	Depth, feet*	Description and Classification
I	B1 – B3	Varies	Sandy, Silty Clay (CL-ML); Grayish Brown, Dark Grayish Brown.
II	B2 - B3	Varies	Clay (CL); Dark Olive Brown.

* The depths and thicknesses of the strata presented are based on information at the borehole locations and variations outside of the ranges of depth and thickness could occur between borehole locations.

The comprehensive evaluation of shear strength, moisture content, volume change characteristics, and plasticity through field and laboratory tests provides a robust foundation for geotechnical engineering design. Understanding these parameters ensures the stability and durability of the structures built on or within the soil, guiding engineers in making informed decisions on foundation design, slope stability, and the construction of retaining structures. The Symbol Key and Unified Soil Classification System (USCS) terms sheets serve as essential references for interpreting the boring logs and applying the data effectively in geotechnical projects.

3.3 Groundwater

During our drilling operations dry to moist conditions were encountered in all bores to the depth drilled. It is noted that groundwater levels will fluctuate with seasonal climatic variations; however, ground water may become a factor affecting foundation design or construction at this site.

4. EVALUATION

4.1 General

All recommendations are based on knowledge of the area; however, the project design team should specify actual construction requirements. The final selection of foundation types and depths should be based on considerations of several factors, such as: 1) function of the structure, 2) soil strength properties, expansive properties, and settlement characteristics of subsurface materials; 3) the magnitude of applied structural loads; and 4) foundation construction costs.

4.2 Potential Vertical Rise (PVR)

The Potential Vertical Rise (PVR) method, as outlined by the Texas Department of Transportation method TEX-124-E, assesses potential vertical soil movements based on in-situ moisture conditions and plasticity characteristics within the active zone. Here, the active zone is estimated to extend to a depth of approximately fifteen (15) feet. At this site, the PVR is calculated to be less than one (1) inch under current conditions. This calculation assumes a sustained surcharge load of one (1) pound per square inch from the floor and sustained live load.

It is important to note that PVR estimates serve as indicators of potential soil movement severity rather than precise predictions of actual soil foundation movements. This estimation helps in understanding and preparing for possible soil behavior changes, which can inform construction and engineering decisions for the site.

4.3 Bearing Capacity and Foundation Stability

As presented in this report, the removal and recompacting of the top two (2) feet of existing soils is recommended. The recompacted soils shall be moisture condition and compacted to 98% of the Standard Proctor prior to any development. Based on the PVR values, SPT field results, settlement, and bearing capacity calculations, the soils below the top two (2) feet of the remaining existing soil have a bearing capacity that averages about 1500 pounds per square foot (psf) and remains with depth. This recommendation is to assure that a good sound subgrade is achieved prior to earthwork operations necessary to achieve the desired finish grade elevations.

Our recommendation is based on the shallow loose soil material encountered, field testing, laboratory test results, and on the Standard Penetration Test N-value (SPT) blow counts reported during drilling and sampling operations. The standard penetration test procedure is described under Section 2 – Field Testing in this report. The SPT N-value is the number of blows of a 140 lb hammer falling 30 inches required to drive the SPT sampler the final 12 inches of an 18-inch sampling interval. The consistency of soils, sands, and gravels is determined by the SPT N-value reported.

Typical ranges for different consistencies are found in the Appendix of the report and are presented herein as follows:

Consistency	Penetration Resistance (N)
Very Loose	0 – 4
Loose	4 – 10
Medium Loose	10 – 30
Dense	30 – 50
Very Dense	Over 50

5.0 RECOMMENDATIONS

5.1 Site Preparation

The Finished Floor Elevation (FFE) was not provided to us. All grades must provide effective drainage away from the building foundation during and after construction.

Site preparation should consist of the following:

1. Strip vegetation and loose topsoil, if any, containing significant organic material from the building pad area. The building pad area includes any patios, canopies, walkways, or other attached structures.
2. The subgrade should then be scarified to at least eight (8) inches; moisture conditioned between minus two (-2) to plus three (+3) percentage points of the optimum moisture and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D 698 (Standard Proctor).
3. Additionally, the removal and recompacting of the top two (2) feet of existing soils is recommended. The recompacted soils shall be moisture condition and compacted

to 98% of the Standard Proctor prior to any development. Based on the PVR values, SPT field results, settlement, and bearing capacity calculations, the top three (3) feet of the remaining existing soil have a bearing capacity that averages about 1900 pounds per square foot (psf). This recommendation is to assure that a good sound subgrade is achieved prior to earthwork operations necessary to achieve the desired finish grade elevations.

4. Structural fill may consist of inorganic sandy clay, clayey gravel, crushed limestone, or caliche with a Liquid Limit (LL) of less than 35 and a Plasticity Index (PI) between seven (7) and fifteen (15). The fill should be placed in compacted lifts not to exceed six (6) inches in thickness, moisture conditioned between minus two (-2) to plus three (+3) percentage points of the optimum moisture and compacted to a minimum of 97 percent of the maximum dry density determined in accordance with ASTM D 698 (Standard Proctor). To provide a more uniform slab support (k value), consideration should be given to constructing the final 12 inches of the building pad using granular select fill. *Additional fill required to achieve the finished pad elevation should consist of select fill and will further reduce the PVR.*
5. Subgrade preparation and fill placement should extend at least three (3) feet beyond the perimeter of the planned building expansion, including covered walkways and other improvements adjacent to the main structure. The final twelve (12) inches of fill outside of the building area should consist of a cohesive clayey (CL) soil. Properly compacted, this clayey layer will reduce migration of moisture into the select fill below. *Particular attention should be given to maintaining the proper moisture content during compaction and to preventing the fill from drying before subsequent lifts are placed.*

Since the soils at this area exhibit moderate potential to experience volume changes as the result of fluctuation in their moisture content; removal of the upper low expansive soils from the building area is not necessary. Section 1802.3, Soil Classification and 1805.8.3, Removal of Expansive Soils, of the 2006 International Building Code does not apply to this site.

5.2 Foundation Discussion

The proposed structure may be supported by shallow foundation types bearing on competent select fill. Foundation excavations will be required to be carefully inspected by a CET representative prior to concrete placement. The purpose of this inspection is to ascertain that the exposed bearing materials are suitable for the design bearing pressure. If incompetent rock or clayey layers are exposed in the bottom of the slab/footing excavations, the unsuitable materials should be removed. The footings should be extended deeper to bear directly upon competent materials and the over excavated areas can be backfilled to the design footing elevation or design bottom with structural concrete.

5.3 Shallow Foundation Design

Slab-on-fill supported foundation systems may be utilized, provided the building pad select fill and supporting subgrade is properly prepared and moisture conditioned, and the stiffened beams be founded a minimum of 24 inches below finish floor grade and the foundation system be on a supporting subgrade of 18 inches of properly prepared, compacted, and moisture conditioned structural fill. The fill supported foundation may be

designed for a bearing capacity of 2200 pounds per square foot (psf) based on the anticipated loads.

Footings bearing on natural soils should be designed for an allowable load net bearing pressure of 2,000 psf. The load bearing pressures include a factor of safety of three (3). The bearing surfaces will be free and clean of soft and moist material or loose debris. Our field representative from Castle Engineering & Testing, LLC, (CET) should check the footing bearing surfaces prior to concrete placement regardless of the bearing material.

These recommendations are for proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. These recommendations are not based on structural considerations. Grade beam depths for both the exterior and interior grade beams may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the structural engineer. The grade beams or slab portions may be thickened and widened to serve as spread footings at concentrated load areas.

CET has no detailed design information regarding the site or building materials proposed; therefore, we still recommend that some interior beams be installed that meet the minimum requirements per an acceptable method for calculating structural loads, deflections, and design stresses. Final foundation design considerations must be based on final structural considerations per the project structural engineer.

If the footing foundations are over excavated and formed, the backfill around the foundation sides should be achieved with compacted select fill, lean concrete, compacted cement stabilized sand (two sacks cement to one cubic yard of sand) or flowable fill. The fill should be placed in compacted lifts not to exceed six (6) inches in thickness, moisture conditioned between minus two (-2) to plus three (+3) percentage points of the optimum moisture and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D 698 (Standard Proctor). Reinforcing steel should be placed and the foundation poured the same day of excavation.

In general, excavations should be protected against surface water runoff and ingress of groundwater; footing bases should not be allowed to dry out excessively during and after construction.

For foundations designed and constructed in accordance with the recommendations in this report and under static loading conditions, total post-construction foundation settlement is expected to be less than about one (1) inch. Post-construction differential settlement is expected to be about half of the total settlement. Settlement of the footings can be reduced to the smallest amount compatible with the general method of construction. In general, the foundation will be considered satisfactory if it does not transmit pressures to the subsoil that exceed the safe load or that will cause excessive settlement.

Table No. 2 – Slab Foundation Design Parameters

	Allowable Bearing Pressure, psf*	
	Dead Load Conditions	Total Load Conditions
Natural Soils	1,900	1,500
Select Fill	3,000	2,000

*The above dead load bearing pressures include a factor of safety of three (3). The total load bearing pressures include a factor of safety of two (2).

BRAB/PCI Methods

	Modified Subgrade*
Effective Plasticity Index (PI)	15
Soil Support Index (C)	1
Climatic Rating C_w	-30
Unconfined Compressive Strength	0.75 tsf

* Based on our "Site Preparation" recommendations.

5.4 Vapor Retarder Membrane

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building, this subsurface moisture will collect. To reduce the impact of this subsurface moisture and the potential impact of introduced moisture (such as landscape irrigation or plumbing leaks) the current industry standard is to place a vapor retarder membrane on the compacted granular layer. This membrane typically consists of visquene or polyvinyl plastic sheeting at least 10 mils in thickness. It should be noted that although capillary break and vapor barrier systems are currently the industry standard, this system may not be completely effective in preventing floor slab moisture problems. These systems will not "moisture proof" the floor slab nor will it assure floor slab moisture transmission rates will meet floor-covering manufacturer standards. The design and construction of such systems are dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may result in excessive moisture in a building and affect indoor air quality.

5.5 Flatwork

For any flatwork outside of the building areas which will be sensitive to movement, subgrade preparation as discussed above should be strongly considered to reduce differential movements between the flatwork and the adjacent structure. If subgrade preparation as given above for structures is not implemented in the exterior flatwork areas, those areas may be susceptible to post construction movements. If these areas do result

with differential movement, it could result in reversed grading with surface runoff and drainage flowing towards the structure.

6.0 OTHER CONSTRUCTION CONSIDERATIONS

When establishing final grade around the residential structure, we recommend the following:

6.1 Drainage

- a. Elevation of ground surface adjacent to the foundation should be a minimum of at least nine (9) inches below Finished Floor Elevation (FFE).
- b. The slope of the ground surface away from the structure should be a minimum of five (5) percent for a distance of at least 10 feet.
- c. Gutter downspouts should extend at least three (3) feet from the face of the building.
- d. A three (3) foot wide mow band around the foundation perimeter can also be installed to mitigate moisture changes affecting the foundation performance.

6.2 Landscaping

Foundation and slab performance depends greatly on how well runoff waters drain from the site. This drainage should be maintained both during construction and over the entire life of the project. The ground surface around structure should be graded so that water flows rapidly away from structure without ponding. Densely vegetated areas should have minimum gradients of five (5) percent away from building in the first five (5) feet if it is practical to do so. Planters should be built so that water exiting from them will not seep into the foundation areas or beneath slab. *In general, the elevation of exterior grades should not be higher than the elevation of the subgrade beneath the slab to help prevent water intrusion beneath slab.* In any event, maintenance personnel should be instructed to limit irrigation to the minimum necessary to properly sustain landscaping plants. Should excessive irrigation, waterline breaks, or unusually high rainfall occur; saturated zones and "perched" groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscaped areas. Potential sources of water, such as water pipes, drains, and the like, should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired.

6.3 Utilities

Shallow foundations are designed to move vertically with underlying soil movements and to deflect or bend within certain limits. It is therefore inadvisable to embed utility lines, heating ducts, or other conduits in the slab. Pipes should pass vertically through the slab and be provided with expansion joints. Service lines should pass beneath the foundation beams or pass-through enlarged openings that will allow for foundation movements.

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective clay "trench plug" that extends at least five (5) feet out from the

face of the building exterior. The plug material should consist of clay compacted in accordance with recommendations in this report.

7. GENERAL REMARKS

7.1 Construction Services

We recommend that Castle Engineering & Testing, LLC be retained to provide construction materials testing services during grading and foundation construction activities. This is to observe compliance with the plans, specifications, and geotechnical recommendations and to allow design changes if the subsurface conditions differ from those anticipated before construction.

7.2 Limitations

The evaluation and recommendations submitted in this report are based, in part, upon the information obtained from the soil borings drilled. The nature and extent of variations in the soil conditions between or beyond the borings and excavations may not become evident until actual construction. The transition lines shown on the boring logs are approximate and the actual transitions may be gradual. If changes in nature or design of the project are planned, the conclusions and recommendations in this report should be reviewed by the soils engineer and, if necessary, modified. Soil samples not altered by laboratory testing will be retained for a period of 30 days and then, unless we are directed otherwise, will be discarded.

This report has been prepared for the exclusive use of **CAVAZOS ARCHITECTS**, and their design team for specific application to the proposed **Laredo College Veterans Center Project** in Laredo, Texas, according to accepted engineering practices. No other warranty, expressed or implied, is made.

APPENDIX

Vicinity Map

Boring Location Plan

Boring Logs

The Symbol Key Sheet

Unified Soil Classification System and Terms Sheet


Field and Laboratory Testing Procedures

LOG OF BORING No. B-1

SHEET 1 of 1

PROJECT: Laredo College Veterans Center
LOCATION: West End Washington Street
CLIENT: Cavazos Architects

PROJECT NUMBER: 24G034
DATE(S) DRILLED: 8/21/24
SURFACE ELEVATION: N/A

	FIELD DATA			LABORATORY DATA								DRILLING METHOD(S):	
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT R: RQD %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	Straight Flight
					LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI						GROUNDWATER INFORMATION: Subsurface water was not encountered during or after completion of drilling operations.
DESCRIPTION OF STRATUM													
	5	N = 22	6	26	19	7						65	-SANDY, SILTY CLAY (CL-ML) w/ TRACES OF GRAVEL -Very Dark Grayish Brown
		N = 15	7										
		N = 14	16	26	20	6						87	-SANDY, SILTY CLAY (CL-ML) -Grayish Brown
		N = 16	12										
	10	N = 12	15	26	20	6	89	-SANDY, SILTY CLAY (CL-ML) -Grayish Brown					
		N = 10	15										
20	N = 10	14	24	20	4	81	-SANDY, SILTY CLAY (CL-ML) -Grayish Brown						
	N = 9	16											
25													Boring Terminated at 25 Feet



REMARKS:

The borehole was backfilled with cuttings upon completion of the drilling operation.

LOG OF BORING No. B-2

SHEET 1 of 1

PROJECT: Laredo College Veterans Center
LOCATION: West End Washington Street
CLIENT: Cavazos Architects

PROJECT NUMBER: 24G034
DATE(S) DRILLED: 8/21/24
SURFACE ELEVATION: N/A

	FIELD DATA			LABORATORY DATA								DRILLING METHOD(S):	
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT R: RQD %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ.FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	Straight Flight
					LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX						GROUNDWATER INFORMATION:
													Subsurface water was not encountered during or after completion of drilling operations.
													DESCRIPTION OF STRATUM
	5	N = 20	6										
		N = 16	10	27	19	8					81	-SANDY LEAN CLAY (CL) -Dark Olive Brown	
		N = 16	13										
	10	N = 13	12	26	19	7					83	-SANDY, SILTY CLAY (CL-ML) -Dark Grayish Brown	
		N = 8	14										
		N = 10	13	24	20	4					78	-SANDY, SILTY CLAY (CL-ML) -Grayish Brown	
15													
													Boring Terminated at 15 Feet
 CASTLE ENGINEERING & TESTING, LLC													REMARKS: The borehole was backfilled with cuttings upon completion of the drilling operation.

LOG OF BORING No. B-3

SHEET 1 of 1

PROJECT: Laredo College Veterans Center
LOCATION: West End Washington Street
CLIENT: Cavazos Architects

PROJECT NUMBER: 24G034
DATE(S) DRILLED: 8/21/24
SURFACE ELEVATION: N/A

	FIELD DATA			LABORATORY DATA								DRILLING METHOD(S):	
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT R: RQD %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ.FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	Straight Flight
					LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI						GROUNDWATER INFORMATION:
													Subsurface water was not encountered during or after completion of drilling operations.
													DESCRIPTION OF STRATUM
	5	N = 18	6	27	19	8						61	-SANDY LEAN CLAY (CL) w/ TRACES OF GRAVEL -Very Dark Grayish Brown
		N = 18	14										
		N = 15	15	25	19	6						86	-SANDY, SILTY CLAY (CL-ML) -Grayish Brown
		N = 13	12										
		N = 11	16	26	19	7						91	-SANDY, SILTY CLAY (CL-ML) -Grayish Brown
	10												
	15	N = 11	14										
													Boring Terminated at 15 Feet
													REMARKS:
													The borehole was backfilled with cuttings upon completion of the drilling operation.

LOG OF BORING - CASTLE GDT - 8/28/24 11:21 - N:\GEO\TECHNICAL\2024\REPORTS\24G034-LC VETERANS CENTER (CAVAZOS ARCHITECTS)\24G034.GPJ





PROJECT: Laredo College Veterans Center

LOCATION: Fort McIntosh Campus
Laredo, Webb County, Texas



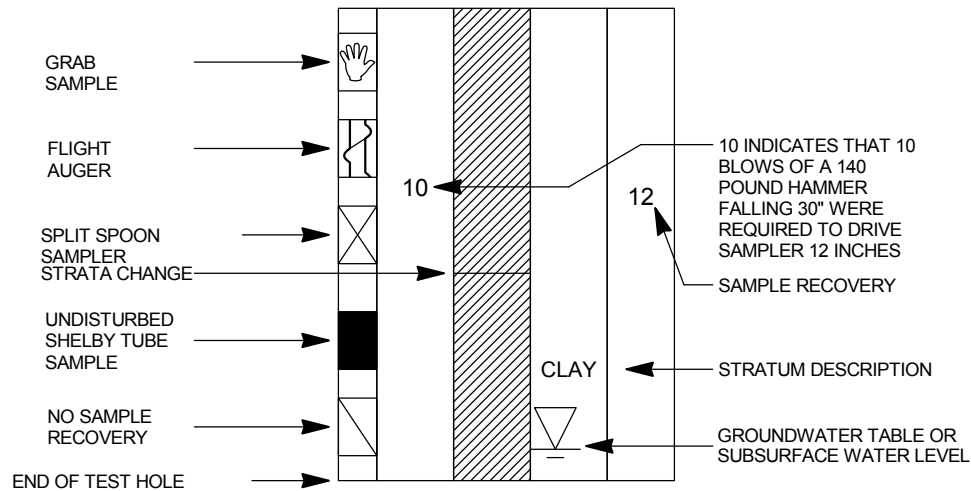
3302 Cuatro Vientos Dr., Ste. 12
Laredo, TX 78046
Phone: 956-727-3530; Fax: 956-727-3384
TBPE: F-10341

SHEET TITLE:

Vicinity Map

Date:
08/27/2024
Prepared for:
Cavazos Architects
Project No.
24G034
Drawn By:
Eloy Robles, Jr.

SYMBOL KEY SHEET



MATERIAL SYMBOLS



FILL



TOPSOIL



PEAT
(PT)



ORGANIC
CLAY (OH)



ORGANIC
SILT (OL)



CLAY
PLASTIC
(CH)



CLAY
(CL)



SILTY
CLAY
(CL-ML)



SILT
PLASTIC
(MH)



SILT
(ML)



SAND
WELL
GRADED
(SW)



SAND
POORLY
GRADED
(SP)



SAND
CLAYEY
(SC)



SAND
SILTY
(SM)



SAND
(SW-SC)



SAND
(SW-SM)



SAND
(SP-SC)



SAND
(SP-SM)



SAND
(SC-SM)



GRAVEL
WELL
GRADED
(GW)



GRAVEL
POORLY
GRADED
(GP)



GRAVEL
CLAYEY
(GC)



GRAVEL
SILTY
(GM)



GRAVEL
(GW-GC)



GRAVEL
(GW-GM)



GRAVEL
(GP-GC)



GRAVEL
(GP-GM)



GRAVEL
(GP-GC)



GRAVEL
(GP-GM)



LIME-
STONE



SHALE



BASALT



SAND-
STONE



BEDROCK



ASPHALT



CONCRETE



BASE



MARL



CLAYSTONE

STANDARD PENETRATION TEST (ASTM D 1586) DRIVING RECORD

Note: Driving is limited to 50 blows per interval, or 25 blows for 0.25 inch advancement, whichever controls. This is done to avoid damaging sampling tools

Blows Per Foot

Description

25
50/4"
ref/2"

Sampler was seated 6 inches, then 25 blows were required to advance the sampler 12 inches.
Sampler was seated 6 inches, then 50 blows were required to advance the sampler 4 inches.
Sampler could only be driven 2 inches of the 6 inch seating penetration before the 50 blow limit was reached.

SAMPLER SYMBOLS



FLIGHT
AUGER



CORE
BARREL



DISTURBED
SAMPLE



NO
RECOVERY



PISTON
SAMPLER



SHELBY
TUBE (3")



SPLIT
BARREL
(SPT)



GRAB
SAMPLE

UNIFIED SOIL CLASSIFICATION SYSTEM AND TERMS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS (major portions retained on No. 200 sieve): includes (1) clean gravel and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests.

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 4
Loose	15 to 35 %	4 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50

FINE-GRAINED SOILS (major portions passing on No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count, or unconfined compression tests.

Descriptive Terms	Unconfined Compressive Strength kPa	SPT Blow Count
Very soft	< 25	< 2
Soft	25 to 50	2 to 4
Medium stiff	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very stiff	200 to 400	15 to 30
Hard	> 400	> 30

GENERAL NOTES

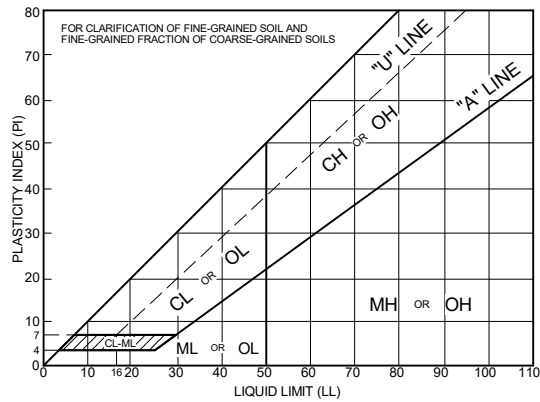
- Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
- Surface elevations are based on topographic maps and estimated locations.
- Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times.

Major Divisions	Group Symbols	Typical Names	Laboratory Classification Criteria	Particle Size	Material
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size) Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Sieve sizes < #200	#200 to #40 #40 to #10 #10 to #4
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		
	Gravel with fines (Appreciable amount of fines)	GM* d u	Silty gravels, gravel-sand-silt mixtures	mm < 0.074	0.074 to 0.42 0.42 to 2.00 2.00 to 4.76
		GC	Clayey gravels, gravel-sand-silt mixtures		
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size) Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	mm < 0.074	0.074 to 0.42 0.42 to 2.00 2.00 to 4.76
		SP	Poorly-graded sands, gravelly sands, little or no fines		
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Sands with fines (Appreciable amount of fines)	SM* d u	Silty sands, sand-silt mixtures	mm < 0.074	Silt or clay Sand Fine Medium Coarse
		SC	Clayey sands, sand-clay mixtures		
	Silt and Clays (Liquid limit less than 60)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	mm < 0.074	#4 to 3/4 in. 3/4 in. to 3 in. 3 in. to 12 in. 12 in. to 36 in.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
		OL	Organic silts and organic silty clays of low plasticity		
	Silt and Clays (Liquid limit greater than 60)	MH	Inorganic silts, micaceous or disto-maceous fine sandy or silty soils, organic silts	mm < 0.074	4.76 to 19.1 19.1 to 76.2 76.2 to 304.8 304.8 to 914.4
		CH	Inorganic clays of high plasticity, fat clays		
		OH	Organic clays of medium to high plasticity, organic silts		
Highly Organic Soils	Pt	Pt	Peat and other highly organic soils	mm < 0.074	Gravel Fine Coarse Cobble Boulders

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

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

$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	Not meeting all gradation requirements for GW
Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
Atterberg limits above "A" line or P.I. greater than 7	
$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	Not meeting all gradation requirements for SW
Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
Atterberg limits above "A" line or P.I. greater than 7	



Plasticity Chart

* Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg Limits: suffix d used when L.L. is 23 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 26.
** Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

FIELD AND LABORATORY TESTING PROCEDURES



FIELD TESTING

A. Boring Procedure Between Samples

The borehole is extended downward, between samples by continuous flight, hollow or stem augers or by rotary drilling techniques using bentonite drilling fluid or water.

B. Penetration Test and Split-Barrel Sampling of Soils (ASTM D-1586)

This sampling method consists of driving a 2-inch outside diameter split barrel sampler using a 140 pound hammer freely falling through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven an additional 12 inches. The number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance. Recovered samples are first classified as to color and texture by the field logger. Later, in the laboratory, the field logger's classification is reviewed by the soils engineer who examines each sample.

C. Thin-Walled Tube Geotechnical Sampling of Soils (ASTM D-1587)

This method consists of pushing thin walled steel tubes, usually 3 inches in diameter, into the soils to be sampled using hydraulic or other means. Cohesive soils are usually to be sampled in this manner and relatively undisturbed samples are recovered.

D. Soil Investigation and Sampling by Auger Borings (ASTM D-1452)

This method consists of augering a hole and removing representative soil samples from the auger flight or bit at 5 foot intervals or with each change in the substrata. Disturbed samples are obtained and this method is, therefore, limited to situations where it is satisfactory to determine the approximate subsurface profile.

E. Diamond Core Drilling for Site Investigation (ASTM D-2113)

This method consists of advancing a hole into hard strata by rotating a single or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings and to cool the bit. Normally, a 2 inch outside diameter by 1½ inch inside diameter (NX) coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and in the laboratory and the cores are stored in partitioned boxes. The core recovery is the length of the material recovered and is expressed as a percentage of the total distance penetrated.

F. Visual – Manual Soil Classification Procedure (ASTM D-2488)

This procedure is a visual – manual soil classification methodology for the description of soil for engineering purposes when precise soil classification is not required.

LABORATORY TESTING

A. Atterberg Limits: Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI) of Soils (ASTM D-4318 or TEX 104-E, 105-E and 106-E)

Atterberg Limits determine the soil's plasticity characteristics. The soil's Plasticity Index (PI) is representative of this characteristic and is the difference between the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid. The PL is the moisture content at which the soil begins to lose its plasticity. The test results are presented on the boring logs adjacent to the appropriate sampling information.

B. Particle Size Analysis of Soils (ASTM D-422 or TEX 110-E)

Grain size analysis tests are performed to determine the particle size and distribution of the samples tested. The grain size distribution of the soils coarser than the Standard No. 200 sieve was determined by passing the sample through a standard set of nested sieves.

C. Laboratory Determination of Water (Moisture) Content of Soil and Rock (ASTM D-2216 or TEX 103-E)

The moisture content of soil is defined as the ratio, expressed as a percentage, of the weight of water in a given soil mass to the weight of solid particles. It is determined by measuring the wet and oven dry weights of a soil sample. The test results are presented on the boring logs.

D. Unconfined Compressive Strength of Cohesive Soil (ASTM D-2166)

The unconfined compressive strength of soil is determined by placing a section of an undisturbed sample into a loading frame and applying an axial load until the sample fails in shear. The test results are presented on the boring logs adjacent to the appropriate sampling information.

E. California Bearing Ratio (CBR) of Lab Compacted Soils (ASTM D-1883)

The CBR test is performed by compacting soil in a six inch diameter mold at the desired density, soaking the sample for four days under a surcharge load approximating the pavement weight and then testing the soils in punching shear. A two inch diameter piston is forced into the soil to determine the resistance to penetration. The CBR is the ratio if the actual load required to produce 0.1 inches of penetration to that producing the same penetration in a standard crushed stone.

F. Swell Test (ASTM D-4546)

The swell test is performed by confining a one inch thick specimen in a 2½ diameter stainless steel ring and loading the specimen to the approximate overburden pressure. The test specimen is then inundated with distilled water and allowed to swell for 48 hours. The volumetric swell is measured as a percentage of the total volume and is converted mathematically to linear swell.

G. Compaction Tests (ASTM D-698, D-1557, TEX 113-E and TEX 114-E)

The compaction test is performed by compacting soil in a steel mold at varying moisture contents. Layers are compacted using a hammer weight and number of blows per layer which vary with the different test procedures, ASTM D-698, D-1557, TEX 113-E and TEX 114-E. The data is plotted and the maximum unit weight and moisture content determined. The test results are given in the appendix with a notation of the test method used.

H. Classification of Soils for Engineering Purposes (Unified Soil Classification System, ASTM D-2487)

This standard describes a system for classifying mineral and organic-mineral soils for engineering purposes based on laboratory determination of particle size characteristics, liquid limit, and plasticity index shall be used when precise classification is required.

I. Amount of Material in Soils Finer Than the No. 200 (75µm) Sieve (ASTM D-1140)

There are two tests methods to cover determination of the amount of material finer than the No. 200 (75 µm) sieve by washing. Method A – Test specimen is not dispersed prior to wash sieving. Method B – Test specimen is dispersed by soaking in water containing a deflocculating agent prior to wash sieving.

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual site-wide subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*



GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733

e-mail: info@geoprofessional.org www.geoprofessional.org

**SECTION 01 10 00
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: LC Veterans Services Center
- B. Owner's Name: Laredo College.
- C. Architect's Name: Cavazos Architects.
- D. The Project consists of the alteration of an existing guardhouse building located at the Laredo College Fort McIntosh Campus. The building will be converted to a Veterans Services Center and will include renovation of the existing main building and demolition and replacement of the existing rear addition.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in the Bid Invitation Forms.

1.03 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of alterations work is indicated on drawings.

1.04 WORK BY OWNER

- A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Date of Substantial Completion. Some items include:
 - 1. Movable cabinets.
 - 2. Furnishings.
 - 3. Small equipment.
 - 4. Artwork.

1.05 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.06 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Time Restrictions:
 - 1. Refer to Bid Invitation Form for Working Hours.

END OF SECTION 01 10 00

This page intentionally left blank

**SECTION 01 21 00
ALLOWANCES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Contingency allowance.
- B. Other allowances.

1.02 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
- B. Funds will be drawn from the Contingency Allowance only by Change Order.
- C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.03 ALLOWANCES SCHEDULE

- A. Contingency Allowance: Include the stipulated sum/price of \$100,000.00 for use upon Owner's instructions.
- B. Landscaping & Irrigation Allowance: Include the stipulated sum/price of \$50,000.00 to be allocated for Landscaping & Irrigation scope of work.
- C. Military Seals Allowance: Include the stipulated sum/price of \$10,000.00 for use upon Owner's instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 21 00

This page intentionally left blank

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
 - 2) Owner's, Architect's, and Contractor's names.
 - b. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).

- 3) Description of Substitution.
 - 4) Differences between proposed substitution and specified item.
 - 5) Description of how proposed substitution affects other parts of work.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Warranties.
 - 6) Other salient features and requirements.
 - 7) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
 - d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- D. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submit request for Substitution for Cause within 30 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- B. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other construction by Owner.
 - c. Other unanticipated project considerations.
- C. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.
 3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
 - 1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION 01 25 00

This page intentionally left blank

**SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Web-based project software service.
- C. Electronic document submittal service.
- D. Preconstruction meeting.
- E. Progress meetings.
- F. Construction progress schedule.
- G. Progress photographs.
- H. Submittals for review, information, and project closeout.
- I. Number of copies of submittals.
- J. Requests for Interpretation (RFI) procedures.
- K. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: General product requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WEB-BASED PROJECT SOFTWARE SERVICE

- A. Web-Based Project Software Service: Owner will provide, administer, and use web-based project software to host and manage project communication and documentation.
 - 1. Cost: Owner pays cost of service.
 - 2. Provide up to 20 user licenses for use by Owner, Architect, Architect's consultants, and other entities involved in the project.
 - 3. Comply with the software service's current published licensing agreements.

4. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
 - a. Representatives of Owner are scheduled and included in this training.
5. Project Closeout: Architect determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.
6. Web-Based Project Software Services: The selected service is:
 - a. Owner Insite.

3.02 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service will be paid by Owner.
- C. Submittal Service: The selected service is:
 1. Owner Insite.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.03 PRECONSTRUCTION MEETING

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
 1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.

4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract, _____ and Architect.
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 7. Scheduling.
 8. Scheduling activities of a Geotechnical Engineer.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

- A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- B. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Special consultants.
 5. Contractor's superintendent.
 6. Major subcontractors.
- C. Agenda:
1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to work.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

- A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.

- C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Foundations in progress and upon completion.
 - 4. Structural framing in progress and upon completion.
 - 5. Enclosure of building, upon completion.
 - 6. Final completion, minimum of ten (10) photos.
- E. Views:
 - 1. Provide aerial photographs from four cardinal views at each specified time, until structure is enclosed.
 - 2. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 3. Consult with Architect for instructions on views required.
 - 4. Provide factual presentation.
 - 5. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
 - 6. Point of View Sketch: Provide sketch identifying point of view of each photograph.
- F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 - 1. Delivery Medium: Via email.
 - 2. File Naming: Include project identification, date and time of view, and view identification.
 - 3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
 - 4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 - 5. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.07 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - 2. Prepare using software provided by the Electronic Document Submittal Service.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).

- d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
 3. Highlight items requiring priority or expedited response.
 4. Highlight items for which a timely response has not been received to date.
 5. Identify and include improper or frivolous RFIs.
- G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.

3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Format schedule to allow tracking of status of submittals throughout duration of construction.
 2. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.
 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.13 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a separate transmittal for each item.
 - 2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - 5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
 - 6. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - 7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - 8. Provide space for Contractor and Architect review stamps.
 - 9. When revised for resubmission, identify all changes made since previous submission.
 - 10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 - 11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 - 12. Submittals not requested will not be recognized or processed.
- B. Product Data Procedures:
 - 1. Submit only information required by individual specification sections.
 - 2. Collect required information into a single submittal.
 - 3. Submit concurrently with related shop drawing submittal.
 - 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 - 2. Do not reproduce Contract Documents to create shop drawings.
 - 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:

1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.14 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 - 2) Non-responsive resubmittals may be rejected.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION 01 30 00

**SECTION 01 40 00
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Control of installation.
- C. Mock-ups.
- D. Tolerances.
- E. Manufacturers' field services.
- F. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 42 16 - Definitions.
- B. Section 01 42 19 - Reference Standards.
- C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2024.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.05 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 - 1. Make corrections as necessary until Architect's approval is issued.
- I. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

2.04 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

2.05 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION 01 40 00

This page intentionally left blank

**SECTION 01 42 16
DEFINITIONS**

PART 1 GENERAL

1.01 SUMMARY

- A. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 42 16

This page intentionally left blank

**SECTION 01 42 19
REFERENCE STANDARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 AA -- ALUMINUM ASSOCIATION, INC.

2.02 AABC -- ASSOCIATED AIR BALANCE COUNCIL

2.03 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

2.04 ACA -- AMERICAN COATINGS ASSOCIATION

2.05 ACI -- AMERICAN CONCRETE INSTITUTE INTERNATIONAL

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 201.2R - Guide to Durable Concrete; 2016.
- C. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- D. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).
- E. ACI 223R-10 - Guide for the Use of Shrinkage-Compensating Concrete; 2010.
- F. ACI 301 - Specifications for Concrete Construction; 2020.
- G. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- H. ACI 303R - Guide to Cast-in-Place Architectural Concrete Practice; 2012.
- I. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- J. ACI 305R - Guide to Hot Weather Concreting; 2020.
- K. ACI 306R - Guide to Cold Weather Concreting; 2016.
- L. ACI 310.1 - Specification for Polished Concrete Slab Finishes; 2020.
- M. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- N. ACI 336.1 - Specification for the Construction of Drilled Piers; 2001.
- O. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- P. ACI 360R - Guide to Design of Slabs-on-Ground; 2010, with Errata (2016).
- Q. ACI 440.1R - Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars; 2015, with Errata (2020).

- R. ACI 440.2R - Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures; 2017, with Errata (2020).
- S. ACI 506.2 - Specification for Shotcrete; 2013 (Reapproved 2018).
- T. ACI 546R - Guide to Concrete Repair; 2014.
- U. ACI 548.14 - Specification for Repairing Concrete with Epoxy Mortar; 2014.
- V. ACI 617 - Specifications for Concrete Pavements and Concrete Bases; 1958.
- W. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- X. ACI MNL-66 - ACI Detailing Manual; 2020.
- Y. ACI PRC-201.2 - Guide to Durable Concrete; 2016.
- Z. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- AA. ACI PRC-213 - Guide for Structural Lightweight-Aggregate Concrete; 2014 (Reapproved 2023).
- BB. ACI PRC-223 - Shrinkage-Compensating Concrete - Guide; 2021.
- CC. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
- DD. ACI PRC-303 - Guide to Cast-in-Place Architectural Concrete Practice; 2012.
- EE. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- FF. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- GG. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- HH. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- II. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- JJ. ACI PRC-440.1 - Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer Bars; 2015.
- KK. ACI PRC-440.2 - Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures; 2017.
- LL. ACI PRC-440.7 - Externally Bonded Fiber-Reinforced Polymer Systems Design and Construction for Strengthening Masonry Structures - Guide; 2022.
- MM. ACI SP-66 - ACI Detailing Manual; 2004.
- NN. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- OO. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- PP. ACI SPEC-336.1 - Specification for the Construction of Drilled Piers; 2001.
- QQ. ACI SPEC-440.8 - Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures; 2013.
- RR. ACI SPEC-506.2 - Specification for Shotcrete; 2013 (Reapproved 2018).
- SS. ACI SPEC-548.14 - Specification for Repairing Concrete with Epoxy Mortar; 2014.

2.06 ADC -- AIR DIFFUSION COUNCIL

2.07 AFPA -- AMERICAN FOREST AND PAPER ASSOCIATION

2.08 AGA -- AMERICAN GALVANIZERS ASSOCIATION, INC.

2.09 AIA -- THE AMERICAN INSTITUTE OF ARCHITECTS

- A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2017.
- B. AIA A201 - General Conditions of the Contract for Construction; 2017.

2.10 AISC -- AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

2.11 AMCA -- AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

2.12 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE

- A. ANSI/ACMA (GM) - FRP Composites Grating Manual for Pultruded and Molded Grating and Stair Treads; 2017.
- B. ANSI/ACMA/PIC (CSP) - Code of Standard Practice, Industry Guidelines for Fabrication and Installation of Pultruded FRP Structures; 2011 (Reapproved 2012).
- C. ANSI/APA PRG 320 - Standard for Performance-Rated Cross-Laminated Timber; 2019.
- D. ANSI/AWI 0400 - Factory Finishing; 2022.
- E. ANSI/AWI 0620 - Finish Carpentry/Installation; 2018.
- F. ANSI/AWI 0641 - Architectural Wood Casework; 2019.
- G. ANSI/BHMA A156.38 - Low Energy Power Operated Sliding and Folding Doors; 2019.
- H. ANSI/FCI 70-2 - Control Valve Seat Leakage; 2021.
- I. ANSI/HI 7.1-7.5 - Controlled-Volume Metering Pumps for Nomenclature, Definitions, Application, and Operation; 2023.
- J. ANSI/HI 9.1-9.5 - Pumps - General Guidelines for Materials, Sound Testing, and Decontamination; 2021.
- K. ANSI/Infocomm 10 - Audiovisual Systems Performance Verification; 2013.
- L. ANSI/IWCA I-14 - Window Cleaning Safety Standard; 2001.
- M. ANSI/NSC 373 - Sustainable Production of Natural Dimension Stone; 2019.
- N. ANSI 405 - Standard for Adhesives for use in Structural Glued Laminated Timber; 2018.
- O. ANSI/ASSP A10.32 - Personal Fall Protection Used in Construction and Demolition Operations; 2012.
- P. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- Q. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- R. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.
- S. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- T. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

- U. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- V. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- W. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- X. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- Y. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
- Z. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- AA. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- BB. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- CC. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- DD. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- EE. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- FF. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.
- GG. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar; 2023.
- HH. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- II. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
- JJ. ANSI A118.5 - American National Standard Specifications for Chemical Resistant Furan Mortars and Grouts for Tile Installation; 1999 (Reaffirmed 2021).
- KK. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
- LL. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
- MM. ANSI A118.8 - American National Standard Specifications for Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2021).
- NN. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- OO. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.

- PP. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).
- QQ. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- RR. ANSI A118.13 - American National Standard Specification for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014 (Reaffirmed 2019).
- SS. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.
- TT. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- UU. ANSI A135.5 - Prefinished Hardboard Paneling; 2012 (Reaffirmed 2020).
- VV. ANSI A135.6 - Engineered Wood Siding; 2012 (Reaffirmed 2020).
- WW. ANSI A135.7 - Engineered Wood Trim; 2012 (Reaffirmed 2020).
- XX. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; 2020.
- YY. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- ZZ. ANSI A137.2 - American National Standard Specifications for Glass Tile; 2022.
- AAA. ANSI A137.3 - American National Standard Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs; 2021.
- BBB. ANSI A137.3/A108.19/A108.20 - American National Standard Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs; 2021.
- CCC. ANSI A138.1 - Green Squared American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials; 2011 (Reaffirmed 2021).
- DDD. ANSI/BHMA A156.29 - Standard for Exit Locks, Exit Alarms, Alarms for Exit Devices; 2017.
- EEE. ANSI A190.1 - Product Standard for Structural Glued Laminated Timber; 2022.
- FFF. ANSI A208.1 - American National Standard for Particleboard; 2022.
- GGG. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- HHH. ANSI A250.3 - American National Standard Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames.; 2007 (R2011).
- III. ANSI A250.4 - American National Standard Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.; 2011.
- JJJ. ANSI A250.6 - Hardware on Standard Steel Doors (Reinforcement--Application).; 2003 (R2009).
- KKK. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.; 2003.
- LLL. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.; 1998 (R2011).
- MMM. ANSI A250.11 - Recommended Erection Instructions for Steel Frames.; 2012.
- NNN. ANSI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies; 2008.
- OOO. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2019.
- PPP. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

- QQQ. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
- RRR. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- SSS. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- TTT. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames; 2022.
- UUU. ANSI/SDI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes; 2008 (Reaffirmed 2018).
- VVV. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.
- WWW. ANSI A300 Part 5 - American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction); 2019.
- XXX. ANSI A300 Part 6 - Tree, Shrub, and Other Woody Plant Management--Standard Practices (Planting and Transplanting); 2012 (Reapproved 2018).
- YYY. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.
- ZZZ. ANSI A1264.1 - Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall and Roof Openings; Stairs and Guardrail/Handrail Systems; 2017.
- AAAA. ANSI/ASSP A1264.2 - Standard for the Provision of Slip Resistance on Walking/Working Surfaces; 2012.
- BBBB. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways; 2022.
- CCCC. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways; 2020.
- DDDD. AGA/ANSI B109 Set - INCLUDES ANSI B109.1, ANSI B109.2, ANSI B109.3, ANSI B109.4; 2000.
- EEEE. ANSI/CEA 709.1.D - Control Network Protocol Specification; 2014.
- FFFF. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2024.
- GGGG. ANSI C12.10 - American National Standard for Physical Aspects of Watthour Meters - Safety Standard; 2011 (Reaffirmed 2021).
- HHHH. ANSI C12.18 - Protocol Specification for ANSI Type 2 Optical Port; 2006 (Reapproved 2016).
- IIII. ANSI C12.19 - Utility Industry End Device Data Tables; 2021.
- JJJJ. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2022.
- KKKK. ANSI C29.2 - American National Standard for Insulators -- Wet-Process Porcelain and Toughened Glass -- Suspension Type; 2012.
- LLLL. ANSI C29.2A - American National Standard for Insulators Wet Process Porcelain and Toughened Glass - Distribution Suspension Type; 2020.
- MMMM. ANSI C29.3 - American National Standard for Wet Process Porcelain Insulators -- Spool Type; 2015 (Reaffirmed 2022).
- NNNN. ANSI C29.4 - American National Standard for Wet-Process Porcelain Insulators -- Strain Type; 2022.

- OOOO. ANSI C29.5 - American National Standard for Wet-Process Porcelain Insulators -- Low- and Medium-Voltage Types; 2022.
- PPPP. ANSI C37.50 - American National Standard for Switchgear - Low Voltage AC Power Circuit Breakers Used In Enclosures - Test Procedures; 2018.
- QQQQ. ANSI C37.51 - American National Standard for Switchgear - Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedures; 2018.
- RRRR. ANSI C37.54 - Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear – Conformance Test Procedures; 2002 (Reaffirmed 2020).
- SSSS. ANSI C37.55 - Medium-Voltage Metal-Clad Switchgear Assemblies – Conformance Test Procedures; 2020.
- TTTT. ANSI C78.379 - Electric Lamps - Classification of the Beam Patterns of Reflector Lamps; 2006, with Supplement (2020).
- UUUU. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- VVVV. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- WWWW. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.
- XXXX. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- YYYY. ANSI C82.1 - American National Standard for Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts; 2004, with Supplement (2020).
- ZZZZ. ANSI C82.4 - American National Standard for Lamp Ballasts - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps; 2017, with Editorial Revision (2022).
- AAAAA. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts; 2023.
- BBBBB. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- CCCCC. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.
- DDDDD. ANSI C137.1 - Lighting Systems – 0-10V Dimming Interface for LED Drivers, Fluorescent Ballasts, and Controls; 2022.
- EEEEE. ANSI E1.11 - Entertainment Technology - USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories; 2024.
- FFFFF. ANSI E1.20 - Entertainment Technology - RDM - Remote Device Management over DMX512 Networks; 2010.
- GGGGG. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- HHHHH. ANSI H35.1/H35.1M - American National Standard Alloy and Temper Designation Systems for Aluminum; 2017.
- IIIII. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- JJJJJ. ANSI MH29.1 - Safety Requirements for Industrial Scissors Lifts; 2020.
- KKKKK. ANSI MH30.1 - Design, Testing, and Utilization of Dock Leveling Devices; 2022.

- LLLLL. ANSI MH30.3 - Performance and Testing of Vehicle Restraining Devices; 2015.
- MMMMM. ANSI O5.1 - American National Standard for Wood Poles: Specifications and Dimensions; 2022.
- NNNNN. ANSI RMS-LB - Radon Mitigation Standards for Schools and Large Buildings; 2018 (Revised 2020).
- OOOOO. ANSI/ASA S1.4 PART 3 - American National Standard Electroacoustics – Sound Level Meters – Part 3: Periodic Tests; 2014 (Reaffirmed 2024).
- PPPPP. ANSI S1.8 - American National Standard Reference Values for Levels Used in Acoustics and Vibrations; 2016 (Reaffirmed 2020).
- QQQQQ. ANSI S1.13 - American National Standard Measurement of Sound Pressure Levels in Air; 2020.
- RRRRR. ANSI S12.1 - American National Standard Guidelines for the Preparation of Standard Procedures to Determine the Noise Emission from Sources; 1983 (Reaffirmed 2023).
- SSSSS. ANSI S12.60 - Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools; 2010.
- TTTTT. ANSI/ASA S12.60 PART 1 - American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools; 2010 (Reaffirmed 2024).
- UUUUU. ANSI/AWI SMA 0643 - Wood Stair, Handrail, and Guard Systems; 2021.
- VVVVV. ANSI/ESD STM7.1 - The Protection of Electrostatic Discharge Susceptible Items Flooring Systems Resistive Characterization; 2021.
- WWWWW. ANSI/ESD S20.20 - For the Development of an Electrostatic Discharge Control Program for – Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices); 2021.
- XXXXX. ANSI Z9.14 - Testing and Performance-Verification Methodologies for Biosafety Level 3 (BSL-3) and Animal Biosafety Level 3 (ABSL-3) Ventilation Systems; 2020.
- YYYYY. ANSI Z9.5 - Laboratory Ventilation; 2022.
- ZZZZZ. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).
- AAAAA. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.
- BBBBB. ANSI Z21.11.1 - American National Standard Gas-Fired Room Heaters - Volume I - Vented Room Heaters; 1998.
- CCCCC. ANSI Z21.11.2 - Gas-Fired Room Heaters, Volume II, Unvented Room Heaters; 2019.
- DDDDD. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2022.
- EEEEEE. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- FFFFFF. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- GGGGG. ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces; 2021.
- HHHHH. ANSI Z21.50 - Vented Decorative Gas Appliances; 2019.
- IIIII. ANSI Z21.60/CSA 2.26 - Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces; 2017.
- JJJJJ. ANSI Z21.66 - Automatic Damper Devices for Use with Gas-Fired Appliances; 2023.

KKKKKK. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.

LLLLLL. ANSI Z21.84 - Standard for Manually Lighted, Natural Gas, Decorative Gas Appliances for Installation in Solid-Fuel Burning Appliances; 2017.

MMMMMM. ANSI Z21.88/CSA 2.33 - Vented Gas Fireplace Heaters; 2019.

NNNNNN. ANSI Z21.91 - Ventless Firebox Enclosures for Gas-Fired Unvented Gas Log Type Room Heaters; 2020.

OOOOOO. ANSI Z21.97/CSA 2.41 - Outdoor Decorative Gas Appliances; 2017, with Errata (2021).

PPPPPP. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.

QQQQQQ. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

RRRRRR. ANSI Z124.3 - American National Standard for Plastic Lavatories; 2005.

SSSSSS. ANSI Z124.4 - Plastic Water Closet Bowls and Tanks; 2006.

TTTTTT. ANSI Z124.6 - American National Standard for Plastic Sinks; 2007.

UUUUUU. ANSI Z124.9 - Plastic Urinal Fixtures; 2004.

VVVVVV. ANSI Z133 - American National Standard for Arboricultural Operations - Safety Requirements; 2017.

WWWWWW. ANSI Z133.1 - American National Standard for Arboricultural Operations - Safety Requirements; 2017.

XXXXXX. ANSI Z223.1 - National Fuel Gas Code; 2024.

YYYYYY. ANSI Z245.2 - American National Standard for Equipment Technology and Operations for Wastes and Recyclable Materials — Stationary Compactors - Safety Requirements for Installation, Maintenance, Operation, Modification and Repair; 2013.

ZZZZZZ. ANSI Z245.5 - American National Standard for Equipment Technology and Operations for Wastes and Recyclable Materials – Baling Equipment – Safety Requirements for Installation, Maintenance, Modification, Repair and Operation; 2013.

AAAAAA. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.

BBBBBB. ANSI/ASSP Z359.0 - Z359 Committee Guidance Document for Definitions and Nomenclature Used in Z359 Fall Protection and Fall Restraint Standards; 2018.

CCCCCC. ANSI/ASSP Z359.1 - The Fall Protection Code; 2020.

DDDDDD. ANSI Z359.1 - The Fall Protection Code; 2016.

EEEEEE. ANSI/ASSP Z359.7 - Qualification and Verification Testing of Fall Protection Products; 2019.

FFFFFF. ANSI/ASSP Z359.11 - Safety Requirements for Full Body Harnesses; 2021.

GGGGGG. ANSI/ASSP Z359.12 - Connecting Components for Personal Fall Arrest Systems; 2019.

HHHHHH. ANSI/ASSP Z359.15 - Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems; 2014.

IIIIII. ANSI/ASSP Z359.16 - Safety Requirements for Climbing Ladder Fall Arrest Systems; 2016.

JJJJJJ. ANSI/ASSP Z359.18 - Safety Requirements for Anchorage Connectors for Active Fall Protection Systems; 2017, with Errata (2021).

KKKKKKK. ANSI Z400.1/Z129.1 - American National Standard for Hazardous Workplace Chemicals – Hazard Evaluation and Safety Data Sheet and Precautionary Labeling Preparation; 2010.

LLLLLLL. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.

MMMMMMM. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.

2.13 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASHRAE (FUND)-2009 - ASHRAE Handbook - Fundamentals; 2009.
- C. ASHRAE (FUND)-2013 - ASHRAE Handbook - Fundamentals; 2017.
- D. ASHRAE (FUND)-2017 - ASHRAE Handbook - Fundamentals; 2017.
- E. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. ASHRAE (HVACA)-2007 - ASHRAE Handbook - HVAC Applications; 2007.
- G. ASHRAE (HVACA)-2011 - ASHRAE Handbook - HVAC Applications; 2011.
- H. ASHRAE (HVACA)-2015 - ASHRAE Handbook - HVAC Applications; 2015.
- I. ASHRAE (REFR) - ASHRAE Handbook - Refrigeration; Most Recent Edition Cited by Referring Code or Reference Standard.
- J. ASHRAE (REFR)-2006 - ASHRAE Handbook - Refrigeration; 2006.
- K. ASHRAE (REFR)-2010 - ASHRAE Handbook - Refrigeration; 2010.
- L. ASHRAE (REFR)-2014 - ASHRAE Handbook - Refrigeration; 2014.
- M. ASHRAE (HVACS) - ASHRAE Handbook - HVAC Systems and Equipment; Most Recent Edition Cited by Referring Code or Reference Standard.
- N. ASHRAE (HVACS)-2008 - ASHRAE Handbook - HVAC Systems and Equipment; 2008.
- O. ASHRAE (HVACS)-2012 - ASHRAE Handbook - HVAC Systems and Equipment; 2012.
- P. ASHRAE (HVACS)-2016 - ASHRAE Handbook - HVAC Systems and Equipment; 2016.
- Q. ASHRAE Guideline 0-2005 - The Commissioning Process; 2005, with Errata (2011) .
- R. ASHRAE Guideline 0-2013 - The Commissioning Process; 2013.
- S. ASHRAE Guideline 0 - The Commissioning Process; 2013.
- T. ASHRAE Guideline 0.2 - Commissioning Process for Existing Systems and Assemblies; 2015.
- U. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).
- V. ASHRAE Guideline 1.5 - The Commissioning Process for Smoke Control Systems; 2017.
- W. ASHRAE Guideline 4 - Preparation of Operations and Maintenance Documentation for HVAC&R Systems; 2019.
- X. ASHRAE Guideline 5 - Guideline to Commissioning Smoke Management Systems; 1994 (Reaffirmed 2001).
- Y. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units;.
- Z. ASHRAE RP-1455 - Seminar 65 - Standardized Best of Class Sequences for HVAC Systems; 2016.

- AA. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).
- BB. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- CC. ASHRAE Std 20 - Methods of Laboratory Testing Remote Mechanical-Draft Air-Cooled Refrigerant Condensers; 2019.
- DD. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- EE. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- FF. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2022, with Errata (2024).
- GG. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
- HH. ASHRAE Std 55 - Thermal Environmental Conditions for Human Occupancy; 2023, with Errata (2024).
- II. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- JJ. ASHRAE Std 62.1-2007 - Ventilation for Acceptable Indoor Air Quality; 2007.
- KK. ASHRAE Std 62.1-2010 - Ventilation for Acceptable Indoor Air Quality; 2010.
- LL. ASHRAE Std 62.1-2013 - Ventilation for Acceptable Indoor Air Quality; 2013.
- MM. ASHRAE Std 62.1-2016 - Ventilation for Acceptable Indoor Air Quality; 2016.
- NN. ASHRAE Std 62.1-2019 - Ventilation for Acceptable Indoor Air Quality; 2019, with Errata and Amendments (2021).
- OO. ASHRAE Std 62.2-2016 - Ventilation and Acceptable Indoor Air Quality in Residential Buildings; 2016.
- PP. ASHRAE Std 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct; 1997.
- QQ. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- RR. ASHRAE Std 84 - Method of Testing Air-to-Air Heat/Energy Exchangers; 2024.
- SS. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- TT. ASHRAE Std 90.1 I-P-2007 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2007.
- UU. ASHRAE Std 90.1 I-P-2010 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2010.
- VV. ASHRAE Std 90.1 I-P-2013 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013.
- WW. ASHRAE Std 90.1 I-P-2016 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2016, with Errata (2019).
- XX. ASHRAE Std 90.1 I-P-2019 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2019, with Errata and Addenda (2021).
- YY. ASHRAE Std 90.2 - High-Performance Energy Design of Residential Buildings; 2024, with Errata.

- ZZ. ASHRAE Std 93 - Methods of Testing to Determine the Thermal Performance of Solar Collectors; 2010, with Errata (2014).
- AAA. ASHRAE Std 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2022.
- BBB. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016, with Errata.
- CCC. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- DDD. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2020.
- EEE. ASHRAE Std 129 - Measuring Air-Change Effectiveness; 1997 (Reaffirmed 2002).
- FFF. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
- GGG. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Addendum (2024).
- HHH. ASHRAE Std 138 - Method of Testing for Rating Ceiling Panels for Sensible Heating and Cooling; 2021.
- III. ASHRAE Std 140 - Method of Test for Evaluating Building Performance Simulation Software; 2020, with Addenda (2023).
- JJJ. ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems; 2019, with Addendum (2024).
- KKK. ASHRAE Std 170 - Ventilation of Health Care Facilities; 2021, with Amendments (2022).
- LLL. ASHRAE Std 180 - Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems; 2018, with Errata (2023).
- MMM. ASHRAE Std 189.1 - Standard for the Design of High-Performance Green Buildings; 2020.
- NNN. ASHRAE Std 189.1-2009 - Standard for the Design of High-Performance Green Buildings; 2009.
- OOO. ASHRAE Std 189.1-2011 - Standard for the Design of High-Performance Green Buildings; 2011.
- PPP. ASHRAE Std 189.1-2014 - Standard for the Design of High-Performance Green Buildings; 2014.
- QQQ. ASHRAE Std 201 - Facility Smart Grid Information Model; 2016, with Errata (2018).
- RRR. ASHRAE Std 202 - The Commissioning Process Requirements for New Buildings and New Systems; 2024.
- SSS. ASHRAE Std 13256-1 - Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps; 2021.

2.14 ASME -- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- C. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, and Dumbwaiters; 2020.
- D. ASME A17.2.1 - Inspector's Manual for Electric Elevators; 1996.

- E. ASME A17.2.2 - Inspector's Manual for Hydraulic Elevators; 1997.
- F. ASME A17.2.3 - Inspector's Manual for Escalators and Moving Walks; 1998.
- G. ASME A18.1 - Safety Standard for Platform Lifts and Stairway Chairlifts; 2023.
- H. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- I. ASME A112.6.3 - Floor Drains; 2022.
- J. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
- K. ASME A112.6.9 - Siphonic Roof Drains; 2005 (Reaffirmed 2019).
- L. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- M. ASME A112.18.2 - Plumbing Waste Fittings; 2020.
- N. ASME A112.18.6 - Flexible Water Connectors; 2017 (Reaffirmed 2021).
- O. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- P. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018, with Errata.
- Q. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.
- R. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (Reaffirmed 2009).
- S. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- T. ASME A112.19.14 - Six-Liter Water Closets Equipped with a Dual Flushing Device; 2013 (Reaffirmed 2018).
- U. ASME A112.19.15 - Bathtubs/Whirlpool Bathtubs with Pressure Sealed Doors; 2012 (Reaffirmed 2022).
- V. ASME A112.19.17 - Manufactured Safety Vacuum Release Systems (SVRS) for Residential and Commercial Swimming Pool, Spa, Hot Tub, and Wading Pool Suction Systems; 2010 (Reaffirmed 2023).
- W. ASME A120.1 - Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance; 2021.
- X. ASME AG-1 - Code on Nuclear Air and Gas Treatment; 2019.
- Y. ASME B1.1 - Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms); 2024.
- Z. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- AA. ASME B1.20.2M - Pipe Threads, 60 Deg, General Purpose; 2006 (Reaffirmed 2011).
- BB. ASME B1.20.7 - Hose Coupling Screw Threads (Inch); 1991 (Reaffirmed 2024).
- CC. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- DD. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- EE. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- FF. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- GG. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2024.
- HH. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- II. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- JJ. ASME B16.12 - Cast Iron Threaded Drainage Fittings; 2019.
- KK. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2024.

- LL. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- MM. ASME B16.20 - Metallic Gaskets for Pipe Flanges; 2023.
- NN. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2021.
- OO. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- PP. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- QQ. ASME B16.24 - Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500; 2021.
- RR. ASME B16.25 - Buttwelding Ends; 2022.
- SS. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- TT. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- UU. ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems; 1992.
- VV. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- WW. ASME B16.39 - Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300; 2019.
- XX. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300; 2021.
- YY. ASME B17.1 - Keys and Keyseats; 1967 (Reaffirmed 2013).
- ZZ. ASME B17.2 - Woodruff Keys and Keyseats; 1967 (Reaffirmed 2013).
- AAA. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012 (Reaffirmed 2021).
- BBB. ASME B18.2.2 - Nuts for General Applications: Machine Screw Nuts; and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series); 2022.
- CCC. ASME B18.5.2.1M - Metric Round Head Short Square Neck Bolts; 2006 (Reaffirmed 2011).
- DDD. ASME B18.5.2.2M - Metric Round Head Square Neck Bolts; 1982 (Reaffirmed 2010).
- EEE. ASME B18.21.1 - Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series); 2009 (Reaffirmed 2016).
- FFF. ASME B18.21.2M - Lock Washers (Metric Series); 1999 (Reaffirmed 2014).
- GGG. ASME B18.22 - Plain Washers; 1965 (Reaffirmed 2008).
- HHH. ASME B18.22M - Metric Plain Washers; 1981 (Reaffirmed 2017).
- III. ASME B20.1 - Safety Standard for Conveyors and Related Equipment; 2021.
- JJJ. ASME B29.100 - Double-Pitch Roller Chains, Attachments, and Sprockets; 2011 (Reaffirmed 2021).
- KKK. ASME B31.1 - Power Piping; 2024.
- LLL. ASME B31.2 - Fuel Gas Piping; 1968.
- MMM. ASME B31.3 - Process Piping; 2022, with Errata (2023).
- NNN. ASME B31.4 - Pipeline Transportation Systems for Liquids and Slurries; 2022.
- OOO. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- PPP. ASME B31.8 - Gas Transmission and Distribution Piping Systems; 2022.
- QQQ. ASME B31.9 - Building Services Piping; 2020.
- RRR. ASME B36.10 - Welded and Seamless Wrought Steel Pipe; 2022.
- SSS. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2022.

- TTT. ASME B36.19M - Stainless Steel Pipe; 2018.
- UUU. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- VVV. ASME B46.1 - Surface Texture (Surface Roughness, Waviness and Lay); 2019.
- WWW. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- XXX. ASME BPVC-I - Boiler and Pressure Vessel Code, Section I: Rules for Construction of Power Boilers; 2023.
- YYY. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.
- ZZZ. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.
- AAAA. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- BBBB. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
- CCCC. ASME PTC 23 - Atmospheric Water Cooling Equipment; 2003 (Reaffirmed 2023).
- DDDD. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors; 2018.

2.15 ASTM A SERIES -- ASTM INTERNATIONAL

2.16 ASTM B SERIES -- ASTM INTERNATIONAL

2.17 ASTM C SERIES -- ASTM INTERNATIONAL

- A. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

2.18 ASTM D SERIES -- ASTM INTERNATIONAL

2.19 ASTM E SERIES -- ASTM INTERNATIONAL

2.20 ASTM F SERIES -- ASTM INTERNATIONAL

2.21 ASTM G SERIES -- ASTM INTERNATIONAL

2.22 AWI -- ARCHITECTURAL WOODWORK INSTITUTE

2.23 CARB -- CALIFORNIA AIR RESOURCES BOARD

- A. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

2.24 CTI -- CERAMIC TILE INSTITUTE

2.25 GA -- GYPSUM ASSOCIATION

2.26 ICC -- INTERNATIONAL CODE COUNCIL, INC.

- A. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

- 2.27 ISO -- INTERNATIONAL STANDARDS ORGANIZATION**
- 2.28 MBMA -- METAL BUILDING MANUFACTURERS ASSOCIATION**
- 2.29 NCMA -- NATIONAL CONCRETE MASONRY ASSOCIATION**
- 2.30 NEMA -- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION**
- 2.31 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION**
- 2.32 NRCA -- NATIONAL ROOFING CONTRACTORS ASSOCIATION**
- 2.33 PCA -- PORTLAND CEMENT ASSOCIATION**
- 2.34 RFCI -- RESILIENT FLOOR COVERING INSTITUTE**
- 2.35 SCAQMD -- SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**
 - A. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- 2.36 SMACNA -- SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.**
- 2.37 SSPC -- SOCIETY FOR PROTECTIVE COATINGS**
 - A. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- 2.38 TCNA -- TILE COUNCIL OF NORTH AMERICA, INC.**
- 2.39 UL -- UNDERWRITERS LABORATORIES INC.**

END OF SECTION 01 42 19

**SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Controls: Barriers, enclosures, and fencing.
- B. Security requirements.
- C. Waste removal facilities and services.
- D. Project identification sign.
- E. Field offices.

1.02 RELATED REQUIREMENTS

- A. Section 01 52 13 - Field Offices and Sheds.
- B. Section 01 55 00 - Vehicular Access and Parking.

1.03 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.04 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.05 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.06 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.07 SECURITY - SEE SECTION 01 35 53

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.08 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 55 00

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.

- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- E. Provide one parking space for Owner use.
- F. Provide one parking space for Architect use.

1.09 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.10 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location established by Architect.
- C. No other signs are allowed without Owner permission except those required by law.

1.11 FIELD OFFICES - SEE SECTION 01 52 13

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 50 00

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 01 40 00 - Quality Requirements: Product quality monitoring.
- C. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- D. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.

- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 61 16.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.
 - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- F. For exterior storage of fabricated products, place on sloped supports above ground.

- G. Provide off-site storage and protection when site does not permit on-site storage or protection.
- H. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- I. Comply with manufacturer's warranty conditions, if any.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 60 00

This page intentionally left blank

**SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, _____.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- G. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary interior partitions.
- C. Section 07 84 00 - Firestopping.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
 - 2. Identify demolition firm and submit qualifications.
 - 3. Include a summary of safety procedures.
- D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.

1.04 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
- B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

- C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.
- D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.
 - 2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 6 pm to 7 am.
- G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.

- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 2. Grid or axis for structures.
 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 1. Verify that construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on drawings.
 2. Relocate items indicated on drawings.
 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.

4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.
- L. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 1. Complete the work.
 2. Fit products together to integrate with other work.
 3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove samples of installed work for testing when requested.
 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.10 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.

- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.11 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect and Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.12 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 70 00

This page intentionally left blank

**SECTION 01 78 00
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 00 72 00 - General Conditions and 00 73 00 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 3 EXECUTION

2.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.

- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.

2.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
 - 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

2.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and

maintenance of the specific products.

- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

2.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.
 - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

2.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 78 00

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Section 31 22 00 - Grading: Rough and fine grading.
- H. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 DEFINITIONS

- A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
- B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
- D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 3 EXECUTION

2.01 DEMOLITION

- A. Remove paving and curbs required to accomplish new work.

- B. Remove other items indicated, for salvage, relocation, and recycling.
- C. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 22 00.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.
- D. Protect existing structures and other elements to remain in place and not removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- E. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- F. Hazardous Materials:
 - 1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- G. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

2.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 - 1. Verify construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction and in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
 - 2. Remove items indicated on drawings.
- E. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

2.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.

- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Cast-in-place concrete includes the following:
 - 1. Foundations and footings.
 - 2. Slabs-on-grade.
 - 3. Equipment pads and bases.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "Portland Cement Concrete Paving" for concrete paving and walks.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others if requested by Engineer.
- C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI SP-66 (88), □ACI Detailing manual," showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.
- D. Shop drawings for formwork indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.
 - 1. Architect's review is for general architectural applications and features only. Designing formwork for structural stability and efficiency is Contractor's responsibility.
- E. Samples of materials as requested by Engineer, including names, sources, and descriptions, as

follows:

1. Color finishes.
 2. Normal weight aggregates.
 3. Reglets.
 4. Waterstops.
 5. Vapor retarder/barrier.
- F. Laboratory test reports for concrete materials and mix design test.
- G. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- H. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- B. Concrete Testing Service: Owner to engage an independent testing laboratory acceptable to Engineer to perform material evaluation tests and to design concrete mixes.
- C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.
- D. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of Project, after Architect's acceptance of visual qualities.
1. Demolish mockup and remove from site when directed by Architect.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following:
1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:

- a. Contractor's superintendent.
- b. Agency responsible for concrete design mixes.
- c. Agency responsible for field quality control.
- d. Ready-mix concrete producer.
- e. Concrete subcontractor.
- f. Primary admixture manufacturers.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
 1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.
 2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
 1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 40 for No. 3 bars, Grade 60 for No. 4 bars and larger, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
- D. Deformed-Steel Welded Wire Fabric: ASTM A 497.

- E. Supports for Reinforcement: Bolsters, chairs, ACI approved precast concrete block supports, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
 - 1. Use one brand of cement throughout Project unless otherwise acceptable to Engineer of Record.
- B. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.
 - 1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
 - 2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Engineer.
- C. Lightweight Aggregates: ASTM C 330.
 - 1. Nominal maximum aggregate size: ☐ inch.
- D. Water: Potable.
- E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Air-Tite, Cormix Construction Chemicals.
 - b. Air-Mix or Perma-Air, Euclid Chemical Co.
 - c. Darex AEA or Daravair, W.R. Grace & Co.
 - d. MB-VR or Micro-Air, Master Builders, Inc.
 - e. Sealtight AEA, W.R. Meadows, Inc.
 - f. Sika AER, Sika Corp.
- G. Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Available Products: Subject to compliance with requirements, products that may be

- incorporated in the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Chemtard, ChemMasters Corp.
 - b. PSI N, Cormix Construction Chemicals.
 - c. Eucon WR-75, Euclid Chemical Co.
 - d. WRDA, W.R. Grace & Co.
 - e. Pozzolith Normal or Polyheed, Master Builders, Inc.
 - f. Metco W.R., Metalcrete Industries.
 - g. Prokrete-N, Prokrete Industries.
 - h. Plastocrete 161, Sika Corp.
- H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Super P, Anti-Hydro Co., Inc.
 - b. Cormix 200, Cormix Construction Chemicals.
 - c. Eucon 37, Euclid Chemical Co.
 - d. WRDA 19 or Daracem, W.R. Grace & Co.
 - e. Rheobuild or Polyheed, Master Builders, Inc.
 - f. Superslump, Metalcrete Industries.
 - g. PSPL, Prokrete Industries.
 - h. Sikament 300, Sika Corp.
- I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Q-Set, Conspec Marketing & Manufacturing Co.
 - b. Lubricon NCA, Cormix Construction Chemicals.
 - c. Accelguard 80, Euclid Chemical Co.
 - d. Daraset, W.R. Grace & Co.
 - e. Pozzutec 20, Master Builders, Inc.
 - f. Accel-Set, Metalcrete Industries.
- J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. PSI-R Plus, Cormix Construction Chemicals.
 - b. Eucon Retarder 75, Euclid Chemical Co.
 - c. Daratard-17, W.R. Grace & Co.
 - d. Pozzolith R, Master Builders, Inc.
 - e. Protard, Prokrete Industries.
 - f. Plastiment, Sika Corporation.

2.4 RELATED MATERIALS

- A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gage) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (22 gage) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
- C. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.
- D. Rubber Waterstops: Corps of Engineers CRD-C 513.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. The Burke Co.
 - b. Progress Unlimited.
 - c. Williams Products, Inc.
- E. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. The Burke Co.
 - b. Greenstreak Plastic Products Co.
 - c. W.R. Meadows, Inc.
 - d. Progress Unlimited.
 - e. Schlegel Corp.
 - f. Vinylex Corp.
- F. Sand Cushion: Clean, manufactured or natural sand.
- G. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
 - 1. Polyethylene sheet not less than 10 mils thick.
- H. Nonslip Aggregate Finish: Provide fused aluminum oxide granules or crushed emery as the abrasive aggregate for a nonslip finish, with emery aggregate containing not less than 50 percent

aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, nonglazing, and unaffected by freezing, moisture, and cleaning materials.

- I. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- J. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.
- K. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.
 - 1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 mg per liter.
 - 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. A-H 3 Way Sealer, Anti-Hydro Co., Inc.
 - b. Spartan-Cote, The Burke Co.
 - c. Conspec #1, Conspec Marketing & Mfg. Co.
 - d. Sealco 309, Cormix Construction Chemicals.
 - e. Day-Chem Cure and Seal, Dayton Superior Corp.
 - f. Eucocure, Euclid Chemical Co.
 - g. Horn Clear Seal, A.C. Horn, Inc.
 - h. L&M Cure R, L&M Construction Chemicals, Inc.
 - i. Masterkure, Master Builders, Inc.
 - j. CS-309, W.R. Meadows, Inc.
 - k. Seal N Kure, Metalcrete Industries.
 - l. Kure-N-Seal, Sonneborn-Chemrex.
 - m. Stontop CS2, Stonhard, Inc.
- L. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Highseal, Conspec Marketing and Mfg. Co.
 - b. Sealco - VOC, Cormix Construction Chemicals.
 - c. Safe Cure and Seal, Dayton Superior Corp.
 - d. Aqua-Cure, Euclid Chemical Co.
 - e. Dress & Seal WB, L&M Construction Chemicals, Inc.
 - f. Masterkure 100W, Master Builders, Inc.
 - g. Vocomp-20, W.R. Meadows, Inc.
 - h. Metcure, Metalcrete Industries.
 - i. Stontop CS1, Stonhard, Inc.

- M. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
3. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 4. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aquafilm, Conspec Marketing and Mfg. Co.
 - b. Eucobar, Euclid Chemical Co.
 - c. E-Con, L&M Construction Chemicals, Inc.
 - d. Confilm, Master Builders, Inc.
 - e. Waterhold, Metalcrete Industries.
- N. Bonding Agent: Polyvinyl acetate or acrylic base.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polyvinyl Acetate (Interior Only):
 1. Superior Concrete Bonder, Dayton Superior Corp.
 2. Euco Weld, Euclid Chemical Co.
 3. Weld-Crete, Larsen Products Corp.
 4. Everweld, L&M Construction Chemicals, Inc.
 5. Herculox, Metalcrete Industries.
 6. Ready Bond, Symons Corp.
 - b. Acrylic or Styrene Butadiene:
 1. Acrylic Bondcrete, The Burke Co.
 2. Strongbond, Conspec Marketing and Mfg. Co.
 3. Day-Chem Ad Bond, Dayton Superior Corp.
 4. SBR Latex, Euclid Chemical Co.
 5. Daraweld C, W.R. Grace & Co.
 6. Hornweld, A.C. Horn, Inc.
 7. Everbond, L&M Construction Chemicals, Inc.
 8. Acryl-Set, Master Builders Inc.
 9. Intralok, W.R. Meadows, Inc.
 10. Acrylpave, Metalcrete Industries.
 11. Sonocrete, Sonneborn-Chemrex.
 12. Stonlock LB2, Stonhard, Inc.
 13. Strong Bond, Symons Corp.
- O. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
 - c. Burke Epoxy M.V., The Burke Co.
 - d. Spec-Bond 100, Conspec Marketing and Mfg. Co.
 - e. Resi-Bond (J-58), Dayton Superior.
 - f. Euco Epoxy System #452 or #620, Euclid Chemical Co.
 - g. Epoxite Binder 2390, A.C. Horn, Inc.
 - h. Epabond, L&M Construction Chemicals, Inc.
 - i. Concrevice Standard Liquid, Master Builders, Inc.
 - j. Rezi-Weld 1000, W.R. Meadows, Inc.
 - k. Metco Hi-Mod Epoxy, Metalcrete Industries.
 - l. Sikadur 32 Hi-Mod, Sika Corp.
 - m. Stonset LV5, Stonhard, Inc.
 - n. R-600 Series, Symons Corp.

2.5 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.
 1. **Do not use the same testing agency for field quality control testing.**
 2. Use of fly ash or calcium chloride will not be permitted in concrete, unless noted otherwise.
- B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:
 1. 3000-psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained). For slabs on grade, grade beam, loading docks & ramps.
 2. 2500-psi, 28-day compressive strength; water-cement ratio, 0.67 maximum (non-air-entrained), 0.54 maximum (air-entrained). For miscellaneous sidewalks and curbs not otherwise called out to have a higher strength.
- D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
 1. Subjected to freezing and thawing: W/C 0.45.
- E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 2. Reinforced foundation systems: Not less than 1 inch and not more than 5 inches.
 3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more

- than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.
4. Other concrete: Not more than 4 inches.

- F. 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, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.6 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
- B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
- C. Use high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water-cement ratios below 0.50.
- D. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

- A. Job-Site Mixing: Mix concrete materials in appropriate drum-type batch machine mixer. For mixers of 1 cu. yd. or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1 cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd.
1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- B. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.
1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials

with placement of forms and reinforcing steel.

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
 - 1. Provide Class A tolerances for concrete surfaces exposed to view.
 - 2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.
- D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

- A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.
- B. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.
 - 1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.
- D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect.
- B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.
- C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.
- D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- E. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's printed instructions.
- F. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1.n Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
- G. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to

form panels of patterns as shown. Use saw cuts 1/8 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
4. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.6 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
- C. Install dovetail anchor slots in concrete structures as indicated on drawings.
- D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.
- B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
 1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing

Concrete," and as specified.

- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
- D. **Placing Concrete in Forms:** Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.
- E. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
 - 1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
 - 2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 - 3. Maintain reinforcing in proper position on chairs during concrete placement.
- F. **Cold-Weather Placement:** Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- H. **Hot-Weather Placement:** When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.
 - 3. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of

- mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
4. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 5. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 6. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 3/4 inch in height rubbed down or chipped off.
- B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than 1 day after form removal.
 1. 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.
- D. Grout-Cleaned Finish: Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.
 1. Combine one part portland cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard portland cement and white portland cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
 2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
- E. 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.

3.10 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.
 - 1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.
 - 1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.
- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.
- E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- F. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.
 - 1. After completing float finishing and before starting trowel finish, uniformly spread 25 lb of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.

2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
- D. Provide moisture curing by the following methods:
 1. Keep concrete surface continuously wet by covering with water.
 2. Use continuous water-fog spray.
 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
- E. Provide moisture-retaining cover curing as follows:
 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as

follows:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
- G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.
1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 REMOVING FORMS

- A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.14 REUSING FORMS

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

3.15 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.
- B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
 - 1. Cut out honeycombs, rock pockets, voids over 3/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
 - 2.n For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
 - 1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 - 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 - 3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
 - 4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

- E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.
- G. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. General: The Owner will employ a testing agency to perform tests and to submit test reports.
- B. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer.
 - 1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - o. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - p. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - q. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
 - r. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - s. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
 - f. For drilled piers, u.n.o., there shall be (1) set of compressive strength test for each 10 cu. Yds.
 - 2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. When total quantity of a given class of concrete is less than 50 cu. yd., Engineer may waive strength testing if adequate evidence of satisfactory strength is provided.
 - 4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - 5. Strength level of concrete will be considered satisfactory if averages of sets of three

consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

- C. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03 30 00

SECTION 04 23 00 REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Requirements of Section "Unit Masonry" apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of each type of reinforced unit masonry work is indicated on drawings and in schedules.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Refer to Section "Unit Masonry" for masonry materials and accessories not included in this section.
- B. Reinforcement Bars: Provide deformed bars of following grades complying with ASTM A 615, except as otherwise indicated.
 - 1. Provide Grade 60 for bars No. 3 to No. 18, except as otherwise indicated.
- C. Shop-fabricate reinforcement bars which are shown to be bent or hooked.

PART 3 - EXECUTION

3.1 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

- B. Position reinforcement accurately at the spacing indicated.
 - 1. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1", whichever is greater.
 - 2. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated.
 - 3. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Architect. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
 - 4. Provide not less than minimum lap indicated, or if not indicated, as required by governing code.
 - 5. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 5/8" on exterior face of walls and 1/2" at other locations.
 - 6. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 5/8" on exterior face of walls and 1/2" at other locations. Lap units not less than 6" at ends. Use prefabricated "L" and "T" units to provide continuity at corners and intersections. Cut and bend units as recommended by manufacturer for continuity at returns, offsets, column fire-proofing, pipe enclosures and other special conditions.
- C. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.
 - 1. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.2 INSTALLATION, GENERAL

- A. Refer to Section "Unit Masonry" for general installation requirements of unit masonry.
- B. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
- C. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.
- D. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.
- E. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period:
 - 1. 10 days for girders and beams.
 - 2. 7 days for slabs.

3. 7 days for reinforced masonry soffits.

3.3 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. GENERAL

1. Do not wet concrete masonry units (CMU).
2. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8" joints.

B. WALLS

1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

C. LOW-LIFT GROUTING

1. Provide minimum clear dimension of 2" and clear area of 8 sq. in. in vertical cores to be grouted.
2. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 ft.
3. Lay CMU to maximum pour height. Do not exceed 4' height, or if bond beam occurs below 4' height stop pour at course below bond beam.
4. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2" below top course of pour.
5. Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown.

Place grout in bond beam course before filling vertical cores above bond beam.

D. HIGH-LIFT GROUTING

1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3" and 10 sq. in., respectively.
2. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.
3. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
4. Construct masonry to full height of maximum height grout pour specified, prior to placing grout.
5. Limit grout lifts to a maximum height of 4' and grout pour to a full height of wall, unless otherwise indicated.
6. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 10'.
7. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
8. Place horizontal beam reinforcement as the masonry units are laid.

E. PREPARATION OF GROUT SPACES

1. Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
2. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
3. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Architect.
4. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 4ft. Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Rod or vibrate each grout lift during pouring operation.
5. Place grout in lintels or beams over openings in one continuous pour.
6. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1" of vertically reinforced cavities, during construction of masonry.

7. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

END OF SECTION 04 23 00

SECTION 04 5313
MASONRY REPAIR AND RESTORATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section includes the following:
 - 1. Re-pointing mortar joints.
 - 2. Replacing damaged or missing brick masonry units.
 - 3. Cleaning of new and existing masonry following pointing and preparation for repainting.

1.03 DEFINITIONS

- A. Re-pointing: The process of raking out (removing) mortar and replacing it with new mortar.
- B. Pointing: The process of placing new mortar in existing joint spaces that have previously been raked out. This term does not include the raking out process.
- C. Tuck pointing: The process of touching up existing mortar joints by filling in recesses with new mortar, without first raking out the joints.
- D. Half-moon: Refers to the configuration of a head joint that has been prepared by removing only a portion of the mortar in the joint by inserting a grinder into the joint and removing the mortar from bed joints.

1.04 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
 - 1. Product Data for each product indicated including recommendations for their application and use. Include test reports and certifications substantiating that products comply with requirements.
 - 2. Samples for verification purposes, prior to erecting the mockup, of the following:
 - a. Each type of mortar for repointing in the form of sample strips of mortar 6 inches long by 1/2-inch wide.
 - b. Submit sample of face brick, in the form of straps of five or more bricks from at least three separate colorways or manufacturers for review and selection by Architect, Engineer, and THC.
 - 3. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
 - 4. Restoration program for each phase of the restoration process, including protection of surrounding materials on building and site during operations. Describe in detail the materials, methods, and equipment to be used for each phase of the restoration work.
- B. If alternative methods and materials to those indicated are proposed for any phase of restoration work, provide a written description, including evidence of successful use on other comparable projects, and a testing program to demonstrate their effectiveness for this Project.
- C. Scope of Work Survey: the contractor shall survey the entire building, each facades to develop a graphic survey denoting all the locations for and areas/quantities (square feet, linear feet, etc.) including various operations for:
 - 1. Mortar joint cut out and re-pointing.

1.05 QUALITY ASSURANCE

- A. Restoration Specialist: Engage an experienced masonry restoration and cleaning firm that has specialized in the types of work required for this Project. At Contractor's option, the work may be divided between two specialist firms: one for cleaning work and one for restoration and repair work.
- B. Field Supervision: Require restoration specialist firm to maintain an experienced full-time supervisor on the job site during times that stone masonry restoration and cleaning are in progress.
- C. Manufacturer Qualifications: A company regularly engaged in producing masonry cleaning compounds, which have been used on similar projects addressing similar stone masonry conditions with successful results, and that retains factory-trained representatives who are available for consultation and job site inspection and assistance at no additional cost.
- D. Field-Constructed Mockups: Prior to start of general masonry restoration, prepare the following sample panels on the building where directed by Architect. Prepare sample panels using same materials and methods proposed for the Work, and under same weather conditions to be expected during time of the Work. Obtain Architect's acceptance of visual qualities before proceeding with the Work. Retain acceptable panels in an undisturbed condition, suitably marked, during construction as a standard for judging the completed Work.
 - 1. Re-pointing: Prepare two separate sample areas approximately 2 feet high by 4 feet wide for each type of re-pointing required, one for demonstrating methods and quality of workmanship expected in removing mortar from joints and the other for demonstrating quality of materials and workmanship expected in pointing mortar joints. Pointed masonry mortar joints are to match the existing mortar joints in color, size, texture, aggregate.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver other materials to Project site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.
- B. Protect masonry restoration materials during storage and construction from rain, snow, and ground water, and from staining or mixing with soil and other materials.
- C. Protect grout, mortar, and other materials from deterioration by moisture and temperature. Store in a dry place or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing.
- D. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

1.07 PROJECT CONDITIONS

- A. Do not repoint mortar joints or repair masonry unless air temperature is above 40 deg F and will remain so for at least 48 hours after completion of Work. Provide temporary shade as required.
- B. Prevent grout or mortar used in re-pointing and repair work from staining face of surrounding masonry and other surfaces. Immediately remove grout and mortar in contact with exposed masonry and other surfaces.
- C. Protect sills, ledges, and projections from mortar droppings.

1.08 SEQUENCING/SCHEDULING

- A. Order replacement materials at the earliest possible date, to avoid delaying completion of the Work.
- B. Perform masonry restoration work in the following sequence:
 - 1. Repair existing masonry, including patching and retrofit anchoring.
 - 2. Rake out existing mortar from joints indicated to be re-pointed.
 - 3. Repoint existing mortar joints of masonry indicated to be restored.
 - 4. Clean existing masonry surfaces. Remove plants, paint, and soot prior to general cleaning.

PART 2 – PRODUCTS

2.01 MASONRY MATERIALS

- A. Salvaged Materials: Intent is to salvage masonry from selective demolition and retain for repairs wherever possible.
- B. Brick Masonry: Provide replacement brick masonry units of material, color, surface texture, and size to match existing historic units.

2.02 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II.
- B. Provide non staining white cement complying with staining requirement of ASTM C 91 for not more than 0.03 percent water-soluble alkali.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate for Mortar: ASTM C 144, unless otherwise indicated.
- E. Match size, texture, color, and gradation of existing mortar aggregate as closely as possible.
- F. Water: Clean, free of oils, acids, alkalis, and organic matter.
- G. Pointing mortar shall be prehydrated Type N, 1 part cement, 1 part lime, 6 parts sand.
 - 1. For interior load-bearing walls and for other applications where another type is not indicated, use Type N, 1 part cement, 1 part lime, 6 parts sand.
 - 2. Preblended, Dry Mortar Mix: If pre-blended mix is to be used, proportioning information must be submitted to confirm conformance with the above ratio Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 - 3. Portland Cement-Lime Mix: Type N.
 - 4. Packaged blend of portland cement complying with ASTM C150, Type I or Type III, and hydrated lime complying with ASTM C207, Type S.
- H. Color Matching: Match color of mortar to the existing adjacent mortar joints, unless specified otherwise.
- I. Face brick: To match existing historic color, texture, size, and finished appearance.
 - a. ASTM C216, Grade SW, Type FBS.
 - b. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 5000 psi.
 - c. Size: Match size of existing installed units. Provide custom manufactured brick as required. Cutting of units of a larger manufactured size is not permitted.

2.03 SEALANT MATERIALS

- A. Exterior sealant to be a non-sag, gun grade, non-staining silicone sealant complying with ASTM C920. Provide one of the following or approved equal:
 - 1. Dow 790.
 - 2. Tremco Spectrem 3.
- B. Backer rod: closed-cell polyethylene or polyurethane rod of diameter 25% larger than the joint width.
- C. Provide primer and joint surface cleaner as recommended by the manufacturer.

2.04 CLEANING MATERIALS AND EQUIPMENT

- A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter.
- B. Brushes: Fiber bristle only.
- C. Masonry cleaner: As required for highly discolored areas: manufacturer's mild acid or gel cleaner for cleaning cast stone, limestone, and brick masonry. Provide one of the following based on manufacturer's recommendations for substrates indicated:

1. Sure Klean 942 Masonry Cleaner, Prosoco., Inc.
 2. Approved equivalent.
- D. Water-Rinsable Chemical Paint Remover: If required to remove paint from surfaces: manufacturer's standard thixotropic water-rinsable solvent formulation for removing paint coatings from masonry.
1. S-301 paint stripper, Cathedral Stone Products, Inc., or approved equal by the Architect.
- E. Spray Equipment: Provide equipment for controlled spray application of water and chemical cleaners, if any, at rates indicated for pressure, measured at spray tip, and for volume. Adjust pressure and volume, as required, to ensure that damage to masonry does not result from cleaning methods.
1. For chemical cleaner spray application, provide low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with a cone-shaped spray tip.
 2. For water spray application, provide a fan-shaped spray tip that disperses water at an angle of not less than 15 degrees.

2.05 REINFORCEMENT/ANCHORS

- A. Stainless steel, Type 304, minimum 8mm helical anchors for retrofit lateral securement of masonry to backup wall, as required.
1. Prosoco Stitch-Tie
 2. Helifix DryFix.
 3. Approved equivalent.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Comply with recommendations of repair mortar and cleaner manufacturers for protecting building surfaces against damage from exposure to their products.
- B. Protect persons, motor vehicles, surrounding surfaces of building whose masonry surfaces are being restored, building site, plants, and surrounding buildings from injury resulting from masonry restoration work.
- C. Prevent chemical cleaning solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings, and other surfaces that could be injured by such contract.
- D. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
- E. Dispose of runoff cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- F. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles that must remain in operation during course of masonry restoration work.
- G. Protect adjacent surfaces from contact with alkali chemical cleaners by covering them either with liquid strippable masking agent or polyethylene film and waterproof masking tape.

3.02 MASONRY UNIT REPLACEMENT

- A. Carefully remove by hand at locations indicated, masonry units that have deteriorated, shifted, or are damaged beyond repair.
- B. Remove mortar, loose particles, and other debris from salvaged units and surrounding units to prepare for resetting.
- C. Replace removed unit with salvaged unit, where possible, or with brick matching existing historic size, color, and texture. Butter vertical joints for full width before setting and set units in full bed of mortar, unless otherwise indicated.

- D. Point new mortar joints to comply with requirements for re-pointing existing masonry and rake out mortar used to set units before mortar sets.
- E. Anchor new units in accordance with the drawings with stainless steel anchoring pins set in mortar bed joints.

3.03 REPOINTING MASONRY

- A. Rake out joints as follows:
 - 1. Rake out mortar from joints to depths equal to 2-1/2 times their widths but not less than 3/4-inch nor less than that required to expose sound, unweathered mortar.
 - 2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 - 3. Do not spall edges of masonry units or widen joints. Replace damaged masonry units.
 - 4. Cut out old mortar by hand with a chisel and mallet, unless otherwise indicated.
 - 5. Do not use power-operated rotary hand saws and grinders unless specific Architect's written approval is obtained based on submission by Contractor of a satisfactory quality control program and demonstrated ability of operators to use tools without damaging masonry. Quality control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
- B. Point joints as follows:
 - 1. Rinse masonry joint surfaces with water to remove dust and mortar particles. Time the rinsing application so that at the time of pointing excess water has evaporated or run off and joint surfaces are damp but free of standing water.
 - 2. Apply the first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8-inch until a uniform depth is formed. Compact each layer thoroughly and allow it to become thumbprint hard before applying the next layer.
 - 3. After joints have been filled to a uniform depth, place remaining pointing mortar in three layers with each of first and second layers filling approximately two-fifths of joint depth and third layer the remaining one-fifth. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing stone has rounded edges, recess final layer slightly from face. Take care not to spread mortar over edges onto exposed masonry surfaces, or to featheredge mortar.
 - 4. When mortar is thumbprint hard, tool joints to match original appearance of joints, unless otherwise indicated. Remove excess mortar from edge of joint by brushing.
- C. Cure mortar by maintaining in a damp condition for not less than 72 hours.
- D. Where re-pointing work precedes cleaning of existing masonry, allow mortar to harden not less than 30 days before beginning cleaning work.

3.04 REPLACING SEALANT

- A. Clean out joints to receive sealant of dirt, grease, or other foreign materials.
- B. Vacuum or brush joints using non-ferrous brush and blow dry.
- C. Install backer rod where joints are deeper than 1/2" or bond breaker tape if less than 1/4", into joint to provide sealant depth recommended by sealant manufacturer. Backer rod size shall be selected to allow for a minimum of 25% compression of the backing when inserted into the joint.
- D. Tape shoulders of joint during installation and tooling of sealant to aid in the removal of excess sealant and to prevent staining of masonry. Remove tape after tooling of joint.
- E. Fill joint completely with sealant in accordance with manufacturer's instructions.
- F. Tool immediately after application to ensure firm, full contact with the inner faces of the joint. Finished bead shall be smooth, continuous, and slightly concave.
- G. Clean excess sealant off adjacent surfaces immediately after tooling and removal of tape. Do not use any cleaners or agents that will stain the sealant or adjacent surfaces.

3.05 CLEANING MASONRY

- A. Use only those cleaning methods approved by manufacturer and via submittal review for each masonry material and location.
- B. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.
- C. Rinse off chemical residue and soil by working upwards from bottom to top of each treated area at each stage or scaffold setting.
- D. Removing Plant Growth: Completely remove plant, moss, and shrub growth completely from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible prior to removal. Remove loose soil or debris from open masonry joints to whatever depth it occurs.
- E. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical manufacturer's recommendations using brush or spray application methods, at Contractor's option, unless otherwise indicated. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.
 - 1. Spray Application: Apply chemical cleaners at pressures not exceeding 50 psi, unless otherwise indicated.
 - 2. Reapplying Chemical Cleaners: Do not apply chemical cleaners to same masonry surfaces more than twice.
- F. Paint Removal with Water-Rinsable Chemical Paint Remover: At locations indicated, remove paint from masonry surfaces as follows:
 - 1. Apply thick coating of water-rinsable chemical paint remover to painted masonry with natural-fiber cleaning brush, deep-nap roller, or large paint brush.
 - 2. Allow chemical paint remover to remain on surface for period recommended by paint remover manufacturer. Agitate periodically with a stiff-bristle brush.
 - 3. Remove chemical and paint residue by rinsing with water applied as follows:
 - 4. Low-pressure spray.

3.06 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, which is spray-applied at low pressure.

END OF SECTION

SECTION 05 40 00 COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Types of cold-formed metal framing units include the following:
 - 1. Load-bearing punched channel studs.
 - 2. C-shaped load-bearing steel studs.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data and installation instructions for each item of cold-formed metal framing and accessories.

1.4 QUALITY ASSURANCE

- A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."
- B. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."
- C. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
- D. Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.
 - 1. Coordinate with provisions of Division 1 Section "Project Meetings."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:
- B. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Alabama Metal Industries Corp.
 - 2. Dale Industries, Inc.
 - 3. Dietrich Industries, Inc.
 - 4. Marino Industries, Inc.
 - 5. Superior Steel Studs, Inc.
 - 6. USG Industries
 - 7. United States Steel
 - 8. Wheeling Corrugating Co.

2.2 METAL FRAMING

- A. System Components: Manufacturers' standard load-bearing steel studs and joists of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacturer's standard, steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.
- B. Materials and Finishes:
 - 1. For 18-gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.
 - 2. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.
 - a. Finish of installation accessories to match that of main framing components, unless otherwise indicated.
 - 3. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.
 - 4. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.
 - 5. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.3 FABRICATION

- A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

- B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
- C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.
- D. Wire tying of framing components is not permitted.
- E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.
- C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.
- D. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
- F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
- H. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- I. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches

o.c. Weld at each intersection.

- J. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
 - 1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

END OF SECTION 05 40 00

SECTION 05 55 00 METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following metal fabrications:
 - 1. Rough hardware.
 - 2. Loose steel lintels.
 - 3. Miscellaneous framing and supports for the following:
 - a. Suspended toilet partitions.
 - b. Applications where framing and supports are not specified in other sections.
 - 4. Pipe bollards.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 5 Section "Structural Steel" for structural steel framing system components.
 - 2. Division 5 Section "Handrails and Railings" for the following:
 - a. Ornamental metal handrails and railing systems.

1.3 DEFINITIONS

- A. Definitions in ASTM E 985 for railing-related terms apply to this section.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935.
- B. Structural Performance: Design, engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
 - 1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 300 lbf applied at any point nonconcurrently, vertically

- downward, or horizontally.
 - b. Uniform load of 100 lbf per linear ft. applied nonconcurrently, vertically downward or horizontally.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
- 2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point nonconcurrently, vertically downward or horizontally.
 - b. Uniform load of 50 lbf per linear foot applied nonconcurrently, vertically downward or horizontally.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
- 3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf applied to one sq. ft. at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
 - a. Above load need not be assumed to act concurrently with uniform horizontal loads on top rails of railing systems in determining stress on guard.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for products used in miscellaneous metal fabrications, including paint products and grout.
- C. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.
 - 1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.
- D. Samples representative of materials and finished products as may be requested by Architect.
- E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.
- F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Architects and Owners, and other information specified.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar

to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

- B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this Project.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.8 SEQUENCING AND SCHEDULING

- A. Sequence and coordinate installation of wall handrails as follows:
 - 1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.
 - 2. Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been clearly marked for benefit of Installer.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those

permitted by reference standards for stretcher-leveled sheet.

- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Rolled Steel Floor Plates: ASTM A 786.
- D. Steel Bars for Gratings: ASTM A 569 or ASTM A 36.
- E. Wire Rod for Grating Cross Bars: ASTM A 510.
- F. Steel Tubing: Product type (manufacturing method) and as follows:
 - 1. Cold-Formed Steel Tubing: ASTM A 500, grade as indicated below:
 - a. Grade A, unless otherwise indicated or required for design loading.
 - b. Grade B, unless otherwise indicated or required for design loading.
 - 2. Hot-Formed Steel Tubing: ASTM A 501.
 - a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.
- G. Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade, as follows:
 - 1. Cold-Rolled Structural Steel Sheet: ASTM A 611, grade as follows:
 - a. Grade A, unless otherwise indicated or required by design loading.
 - 2. Hot-Rolled Structural Steel Sheet: ASTM A 570, grade as follows:
 - a. Grade 30, unless otherwise indicated or required by design loading.
- H. Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:
 - 1. Cold-Rolled Steel Sheet: ASTM A 366.
- I. Galvanized Steel Sheet: Quality as follows:
 - 1. Structural Quality: ASTM A 446; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.
- J. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
 - 1. Black finish, unless otherwise indicated.
 - 2. Galvanized finish for exterior installations and where indicated.
 - 3. Type F, standard weight (schedule 40), unless otherwise indicated, or another weight, type, and grade required by structural loads.
- K. Gray Iron Castings: ASTM A 48, Class 30.

- L. Malleable Iron Castings: ASTM A 47, grade 32510.
- M. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- N. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.
- O. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

2.2 STAINLESS STEEL

- A. Bar Stock: ASTM A 276, Type 302 or 304.
- B. Plate: ASTM A 167, Type 302 or 304.

2.3 ALUMINUM

- A. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
 - 1. 6061-T6 or 6063-T6 for bearing bars of gratings and shapes.
 - 2. 6061-T1 for grating cross bars.
- B. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, alloys as follows:
 - 1. 6061-T6 for platforms.
 - 2. 6061-T4 for treads.
- C. Aluminum Rivets: ASTM B 316, alloy 6053-T4 or 6061-T6.
- D. Aluminum Sheet for Expanded Aluminum Grating: ASTM B 209, alloy 5052-H32.
- E. Fasteners for Aluminum Gratings: Use fasteners made of same basic metal as fastened metal except use galvanized fasteners complying with ASTM A 153 for exterior aluminum units, unless otherwise indicated. Do not use metals that are corrosive or incompatible with metals joined.

2.4 GROUT AND ANCHORING CEMENT

- A. Nonshrink Metallic Grout: Premixed, factory-packaged, ferrous aggregate grout complying with CE CRD-C 621, specifically recommended by manufacturer for heavy duty loading applications of type specified in this section.
- B. Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD- C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

- C. Interior Anchoring Cement: Factory-prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.
- D. Erosion-Resistant Anchoring Cement: Factory-prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.
- E. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include but are not limited to the following:
- F. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Nonshrink Metallic Grouts:
 - a. "Metox RM"; Chem-Masters Corp.
 - b. "Hi Mod Grout"; Euclid Chemical Co.
 - c. "Embeco 885 and 636"; Master Builders.
 - d. "Ferrolith G Redi-Mix and G-NC"; Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
 - e. "Stoncrete MG1"; Stonhard, Inc.
 - 2. Nonshrink Nonmetallic Grouts:
 - a. "Bonsal Construction Grout"; W. R. Bonsal Co.
 - b. "Diamond-Crete Grout"; Concrete Service Materials Co.
 - c. "Euco N-S Grout"; Euclid Chemical Co.
 - d. "Kemset"; Chem-Masters Corp.
 - e. "Crystex"; L & M Construction Chemicals, Inc.
 - f. "Masterflow 713"; Master Builders.
 - g. "Sealtight 588 Grout"; W. R. Meadows, Inc.
 - h. "Sonogrout"; Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
 - i. "Stoncrete NM1"; Stonhard, Inc.
 - j. "Five Star Grout"; U. S. Grout Corp.
 - k. "Vibropruf #11"; Lambert Corp.
 - 3. Interior Anchoring Cement:
 - a. "Bonsal Anchor Cement"; W. R. Bonsal Co.
 - b. "Por-Rok"; Minwax Construction Products Division.
 - 4. Erosion-Resistant Anchoring Cement:
 - a. "Super Por-Rok"; Minwax Construction Products Division.

2.5 FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
- C. Lag Bolts: Square head type, FS FF-B-561.
- D. Machine Screws: Cadmium plated steel, FS FF-S-92.
- E. Wood Screws: Flat head carbon steel, FS FF-S-111.
- F. Plain Washers: Round, carbon steel, FS FF-W-92.
- G. Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade 5.
- H. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.
- I. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.6 PAINT

- A. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-645.
- B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.
- D. Zinc Chromate Primer: FS TT-P-645.

2.7 CONCRETE FILL AND REINFORCING MATERIALS

- A. Concrete Materials and Properties: Comply with requirements of Division 3 section "Concrete Work" for normal weight, ready-mix concrete with minimum 28-day compressive strength of 2,500 psi, 440 lb cement per cu. ft. minimum, and W/C ratio of 0.65 maximum, unless higher strengths indicated.
- B. Nonslip Aggregate Finish: Factory-graded, packaged material containing fused aluminum oxide grits or crushed emery as abrasive aggregate; rust-proof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

- C. Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.

2.8 FABRICATION, GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 100 deg F (55.5 deg C).
- D. Shear and punch metals cleanly and accurately. Remove burrs.
- E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. Remove sharp or rough areas on exposed traffic surfaces.
- G. Weld corners and seams continuously to comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- J. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- K. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

- L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.9 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
- B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.10 STEEL LADDERS

- A. General: Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.
- B. Siderails: Continuous steel flat bars, 1/2 inch x 2-1/2 inches, with eased edges, spaced 18 inches apart.
- C. Bar Rungs: Round steel bars, 3/4 inch diameter, spaced 12 inches o.c.
- D. Bar Rungs: Square steel bars, 3/4 inch, spaced 12 inches o.c.
- E. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
- F. Support each ladder at top and bottom and at intermediate points spaced not more than 5'-0" o.c. by means of welded or bolted steel brackets.
 - 1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
 - 2. Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.
- G. Provide non-slip surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a type of manufactured rung which is filled with aluminum oxide grout.

2.11 SHIP'S LADDERS

- A. Provide ship's ladders where indicated. Fabricate of open type construction with structural steel channel or steel plate stringers, pipe handrails, and open steel grating treads, unless otherwise indicated. Provide all necessary brackets and fittings for installation.
- B. Galvanize ladders, including, brackets and fasteners; in the following locations:

1. Exterior locations.
2. Interior locations where indicated.

2.12 LADDER SAFETY CAGES

- A. General: Fabricate ladder safety cages to comply with ANSI A14.3; assemble by welding or riveting.
- B. Primary Hoops: Steel bars, 5/16 inch x 4 inches, for top, bottom, and for cages longer than 20 feet, intermediate hoops spaced not more than 20'-0" o.c.
- C. Secondary Intermediate Hoops: Steel bars, 5/16 inch x 2 inches hoops spaced not more than 4'-0" o.c. between primary hoops.
- D. Vertical Bars: Steel bars, 5/16 inch x 2 inches, secured to each hoop, spaced approximately 9 inches o.c.
- E. Fasten assembled safety cage to ladder rails and adjacent construction as indicated.
- F. Galvanize ladder safety cages, including fasteners, in the following locations:
 1. Exterior locations.
 2. Interior locations, where indicated.

2.13 NOSINGS

- A. Fabricate curb nosings from structural steel shapes as indicated, of all welded construction with mitered corners and continuously welded joints. Provide anchors welded to nosings for embedding in concrete or masonry construction, spaced not more than 6 inches from each curb end, 6 inches from corners and 24 inches o.c., unless otherwise indicated.
- B. Galvanize nosings in the following locations:
 1. Exterior locations.
 2. Interior locations where indicated.

2.14 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.15 LOOSE STEEL LINTELS

- A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

- B. Weld adjoining members together to form a single unit where indicated.
- C. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.
- D. Galvanize loose steel lintels located in exterior walls.

2.16 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
 - b. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide x 1/4 inch x 8 inches long.
- C. Fabricate support for suspended toilet partitions as follows:
 - 1. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C 8 x 11.5 channels or another shape with equivalent structural properties.
 - 2. Hangers: Steel rods, 1/2 inch in diameter, spaced not more than 36 inches o.c. Thread rods to receive anchor and stop nuts. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
 - 3. Braces and Angles: Steel angles of size required for rigid support of beam and for secure anchorage.
- D. Galvanize miscellaneous framing and supports in the following locations:
 - 1. Exterior locations.
 - 2. Interior locations where indicated.

2.17 MISCELLANEOUS STEEL TRIM

- A. Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.
- B. Galvanize miscellaneous framing and supports in the following locations:

1. Exterior locations.
2. Interior locations where indicated.

2.18 SHELF AND RELIEVING ANGLES

- A. Fabricate shelf and relieving angles from steel angles of sizes indicated and for attachment to concrete framing. Provide slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches o.c., unless otherwise indicated.
- B. For cavity walls, provide vertical channel brackets to support shelf/relieving angles from back-up masonry and concrete. Align expansion joints in angles with indicated expansion joints in cavity wall exterior wythe.
- C. Galvanize shelf angles to be installed on exterior concrete framing.
- D. Furnish wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.

2.19 STEEL PIPE RAILINGS AND HANDRAILS

- A. General: Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.
- B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
 1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
- C. Form changes in direction of railing members as follows:
 1. By insertion of prefabricated elbow fittings.
 2. By radius bends of radius indicated.
 3. By mitering at elbow bends.
 4. By bending.
 5. By any method indicated above, applicable to change of direction involved.
- D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- E. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- F. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.
- G. Toe Boards: Where indicated, provide toe boards at railings around openings and at the edge of

open-sided floors and platforms. Fabricate to dimensions and details indicated, or if not indicated, use 4 inches high x 1/8 inch steel plate welded to, and centered between, each railing post.

- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.
 - 1. For railing posts set in concrete fabricate sleeves from steel pipe not less than 6 inches long and with an inside diameter not less than 1/2 inch greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
 - c. Provide friction fit, removable covers designed to keep sleeves clean and hold top edge of sleeve 1/2 inch below finished surface of concrete.
 - 2. For removable railing posts, fabricate slip-fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height. Provide socket covers designed and fabricated to resist accidental dislodgement.
- I. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.
- J. For exterior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.
- K. For interior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.
- L. For interior steel railings formed from steel pipe with black finish, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.20 CAST TREADS AND THRESHOLDS

- A. Fabricate units of material, sizes, and configurations indicated. If not indicated, provide cast-iron units with integral abrasive finish. Furnish in lengths as required to accurately fit each opening or conditions.
 - 1. Cast units with an integral abrasive grit consisting of aluminum oxide, silicone carbide, or a combination of both.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Abrasive Metals Co.

2. American Mason Safety Tread Co.
 3. American Safety Tread Co., Inc.
 4. Armstrong Products, Inc.
 5. Safe-T-Metal Co., Inc.
 6. Wooster Products Inc.
- D. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.
- E. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by the manufacturer.
1. Provide 2 rows of holes for units over 5 inches wide, with 2 holes aligned at ends and staggered intermediate holes.
- F. Apply black asphaltic coating to concealed bottoms, sides, and edges of cast-iron units set into concrete.
- G. Provide a plain surface texture, except where fluted or cross-hatched surfaces are indicated.

2.21 STEEL FRAMED STAIRS

- A. General: Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
1. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated:
 - d. Commercial class, unless otherwise indicated.
 - e. Architectural class where indicated.
 2. Fabricate treads and platforms of exterior stairs to accommodate slopes to drain in finished traffic surfaces.
- B. Stair Framing: Fabricate stringers of structural steel channels, or plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.
1. Where masonry walls support steel stairs, provide temporary supporting struts designed for erection of steel stair components before installation of masonry.
- C. Metal Pan Risers, Subtreads, and Subplatforms: Shape metal pans for risers and subtreads to conform to configuration shown. Provide thicknesses of structural steel sheet for metal pans

indicated, but not less than that required, to support total design loading.

1. Form metal pans of galvanized steel sheet, where indicated.
2. Directly weld risers and subtreads to stringers; locate welds on side of metal pans to be concealed by concrete fill.
3. Attach risers and subtreads to stringers by means of brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting or bolting.
 - a. At Contractor's option, provide prefabricated stair assemblies with prefilled treads consisting of pre-poured reinforced concrete fill, with non-slip aggregate finish, in welded sheet metal pan, attached to installed stringers using manufacturer's standard connection detail.
 - 1) Product: Subject to compliance with requirements, provide Speedstair by American Stair Corp., Inc.
- 4.. Provide subplatforms of configuration and construction indicated; if not indicated, of same metal as risers and subtreads, in thicknesses required to support design loading. Attach subplatform to platform framing members with welds.
 - a. Smooth Soffit Construction: Construct subplatforms with smooth soffits.
- D. Steel Floor Plate Treads and Platforms: Provide raised pattern steel floor plate in pattern indicated or, if not indicated, as selected from manufacturer's standard patterns.
 1. Form treads of 1/4 inch thick raised pattern steel floor plate with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and treads to brackets.
 2. Fabricate platforms of raised pattern steel floor plate of thickness indicated. Provide nosing matching that on treads at all landings. Secure to platform framing members with welds.
- E. Floor Grating Treads and Platforms: Provide patterns, spacing, and bar sizes indicated; fabricate to comply with NAAMM "Metal Bar Grating Manual."
 1. Finish: Shop prime paint.
- F. Fabricate grating treads with steel plate nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
- G. Fabricate grating platforms, with nosing matching that on grating treads, at all landings. Provide toe plates at open-sided edges of grating platform. Secure grating to platform frame with welds.
- H. Stair Railings and Handrails: Comply with applicable requirements specified elsewhere in this section for steel pipe railings and handrails, and as follows:
 1. Fabricate newels of steel tubing and provide newel caps of gray-iron castings, as shown.
 2. Railings may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 3. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

2.22 WHEEL GUARDS

- A. Provide wheel guards of 3/4 inch thick, hollow core, gray-iron castings, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.

2.23 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 80 steel pipe. Cap bollards with 1/4 inch minimum thickness steel base plate.
- B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4 inch thick steel plate welded to bottom of sleeve.

2.24 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish metal fabrications after assembly.

2.25 STEEL AND IRON FINISHES

- A. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process compliance with the following requirements:
 - 1. ASTM A 153 for galvanizing iron and steel hardware.
 - 2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning:"
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
 - 1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

2.26 ALUMINUM FINISHES

- A. Finish designations prefixed by "AA" conform to the system established by the Aluminum

Association for designating aluminum finishes.

- B. As Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I Clear Anodized Finish: AA-M12C22A41 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural: clear film thicker than 0.7 mil) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Center nosings on tread widths with noses flush with riser faces and tread surfaces.
- C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

3.3 SETTING LOOSE PLATES

- A. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- B. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 1. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.
 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLATION OF SUPPORTS FOR TOILET PARTITIONS

- A. Anchor supports securely to, and rigidly brace from, overhead building structure.

3.5 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

- A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 1. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
 2. Anchor posts in concrete by core drilling holes not less than 5 inches deep and 3/4 inch greater than outside diameter of post. Clean holes of all loose material, insert posts and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
 - a. Nonshrink, nonmetallic grout or anchoring cement.
 - b. Cover anchorage joint with a round steel flange attached to post as follows:
 - 1) Welded to post after placement of anchoring material.
 - 2) By set screws.
 - c. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8 inch build-up, sloped away from post. For installations exposed on exterior, or to

flow of water, seal anchoring material to comply with grout manufacturer's directions.

3. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
 4. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.
 5. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and bolted to structural steel members, unless otherwise indicated.
 6. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.
- B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 2. Use type of bracket with pre-drilled hole for exposed bolt anchorage.
 3. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 4. For hollow masonry anchorage, use toggle bolts having square heads.
 5. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with stud installations for accurate location of backing members.
 6. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.
- C. Expansion Joints: Provide expansion joints at locations indicated, or if not indicated, at intervals not to exceed 40 feet. Provide slip joint with internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of posts.

3.6 INSTALLATION OF CAST TREADS AND THRESHOLDS

- A. Install cast treads and thresholds with anchorage system indicated to comply with manufacturer's recommendations.
- B. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 7 Section "Joint Sealers" to provide a watertight installation.

3.7 INSTALLATION OF WHEEL GUARDS

- A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's instructions. Fill cores solidly with air-entrained concrete having a 28-day minimum compressive strength at 3,000 psi.

3.8 INSTALLATION OF BOLLARDS

- A. Anchor bollards in concrete by means of pipe sleeves preset and anchored into concrete. After

bollards have been inserted into sleeves, fill annular space between bollard and sleeve solid with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.

3.9 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section "Painting" of these specifications.
- C. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05 55 00

SECTION 06 10 00 ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Wood grounds, nailers, and blocking.
 - 4. Wood furring.
 - 5. Sheathing.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Prefabricated Metal-Plate-Connected Wood Trusses."
 - 2. Division 6 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.
 - 3. Division 6 Section "Exterior Architectural Woodwork" for exterior woodwork specially fabricated for this Project.
 - 4. Division 6 Section "Interior Architectural Woodwork" for interior woodwork specially fabricated for this Project.

1.3 DEFINITIONS

- A. Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following products:
 - 1. Engineered wood products.

2. Insulating sheathing.
 3. Metal framing anchors.
 4. Construction adhesives.
- C. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.
- D. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:
1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
- E. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and building code in effect for Project.
1. Engineered wood products.
 2. Metal framing anchors.
 3. Power driven fasteners.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood products from one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
1. SPIB - Southern Pine Inspection Bureau.
 2. WCLIB - West Coast Lumber Inspection Bureau.

3. WWPA - Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 1. For exposed lumber furnish pieces with grade stamps applied to ends or back of each piece; or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.
- D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
 1. Provide dressed lumber, S4S, unless otherwise indicated.
 2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.2 DIMENSION LUMBER

- A. For light framing provide "Stud," "No. 3," or "Standard" grade lumber for stud framing (2 to 4 inches thick, 2 to 4 inches wide, 10 feet and shorter) and "Stud" or "No. 3" grade for other light framing (2 to 4 inches thick, 2 to 6 inches wide), any species.
- B. For structural framing (2 to 4 inches thick, 5 inches and wider), provide the following grade and species:
 1. Southern Pine graded under SPIB rules.
- C. For exposed framing lumber provide material complying with the following requirements:
 1. Definition: Exposed framing refers to dimension lumber that is not concealed by other construction and is indicated to receive a stained or natural finish.
 2. Grading: Material hand-selected at factory from lumber of species and grade indicated below that complies with "Appearance" grade requirements of ALSC National Grading Rule; issue inspection certificate of inspection agency for selected material.
 - a. Same species and grade as indicated for structural framing.

2.3 BOARDS

- A. Exposed Boards: Where boards will be exposed in the finished work, provide the following:
 1. Where transparent or natural finish or no finish is indicated, provide the following:
 - a. Western Red Cedar, "C Select/A All Heart" grade per WWPA rules.
 2. Where painted finish is indicated, provide "No. 1 Boards" per SPIB rules, "Select Merchantable Boards" per WCLIB rules, or "No. 2 Common Boards & Better" per WWPA

rules.

- B. Concealed Boards: Where boards will be concealed by other work, provide lumber of 19 percent maximum moisture content (S-DRY or KD-19) and of following species and grade:
 - 1. Redwood "Construction Common" per RIS rules, Southern Pine "No. 2 Boards" per SPIB rules, or any species graded "Construction Boards" or "No. 3 Common" per WCLIB or WWPAA rules.
 - 2. Redwood "Merchantable" per RIS rules, Southern Pine "No. 2 Boards" per SPIB rules, or any species graded "Standard" or "No. 3 Common Boards" per WCLIB or WWPAA rules.
- C. Board Sizes: Provide sizes indicated or, if not indicated (for sheathing, subflooring and similar uses), provide 1-inch by 8-inch boards.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 3 Common" or "Standard" grade boards per WCLIB or WWPAA rules or "No. 2 Boards" per SPIB rules.

2.5 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products for which current model code evaluation/research reports exist that are acceptable to authorities having jurisdiction and that evidence compliance for the application indicated with specified requirements and the building code in effect for this Project.
- B. Laminated Veneer Lumber: Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesives complying with ASTM D 2559 to produce members with grain of veneers parallel with their lengths and complying with the following requirements:
 - 1. Veneer Characteristics: Douglas fir or southern pine veneers of varying thickness by widths and lengths standard with manufacturer, end-jointed with a lap-joint, butt joint, or scarf joint.
 - 2. Allowable Design Stresses: As published by manufacturer, determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
 - 3. Allowable Design Stresses: As follows, determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing laboratory:
 - a. Extreme Fiber Stress in Bending (Fb): 2400 psi (for 12-inch deep members).
 - b. Modulus of Elasticity (E): 1,700,000 psi.

- c. Tension parallel to Grain (Ft): 1150 psi.
- d. Compression Parallel to Grain (Fc): 1700 psi.
- e. Compression Perpendicular to Grain: 650 psi
- f. Horizontal Shear (Fv): 200 psi

4. Sizes: As indicated.

2.6 PARTICLEBOARD

- A. General: Manufacture and factory-mark each particleboard panel to comply with ANSI A 208.1 for grade indicated. Provide thickness indicated.
- B. Particleboard Underlayment: Grade 1-M-1, factory marked with NPA grade mark "Floor Underlayment."
- C. Particleboard Subflooring: Grade 2-M-W (waferboard) or Grade 2-M-3.
- D. Particleboard Wall Sheathing: Grade 2-M-1.
- E. Particleboard Roof Sheathing: Grade 2-M-W (waferboard).

2.7 GYPSUM SHEATHING

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Gypsum Sheathing Board with Water-Resistant Core, Regular Type:
 - a. "Centex American Gypsum Sheathing," Centex American Gypsum Co.
 - b. "Gyproc Gypsum Sheathing," Domtar Gypsum Co.
 - c. "G-P Gypsum Sheathing," Georgia-Pacific Corp.
 - d. "Gold Bond Gypsum Sheathing," Gold Bond Building Products Div., National Gypsum Co.
 - e. "USG Gypsum Sheathing," United States Gypsum Co.
 - 2. Gypsum Sheathing Board with Water-Resistant Core, Type X:
 - a. "Centex American Gypsum Sheathing," Centex American Gypsum Co.
 - b. "Gyproc Fireguard Sheathing," Domtar Gypsum Co.
 - c. "G-P Firestop Sheathing," Georgia-Pacific Corp.
 - d. "Gold Bond Fire Shield Jumbo Sheathing," Gold Bond Building Products Div., National Gypsum Co.
 - e. "USG Firecode Type X Gypsum Sheathing," United States Gypsum Co.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in

this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power Driven Fasteners: National Evaluation Report NER-272.
- D. Wood Screws: ANSI B18.6.1.
- E. Lag Bolts: ANSI B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.9 METAL FRAMING ANCHORS

- A. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
 1. Current Evaluation/Research Reports: Provide products for which model code evaluation/research reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with the building code in effect for this Project.
 2. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
- B. Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A 525 for Coating Designation G60 and with ASTM A 446, Grade A (structural quality); ASTM A 526 (commercial quality); or ASTM A 527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.
 1. Use galvanized steel framing anchors for rough carpentry exposed to weather, in ground contact, or in area of high relative humidity, and where indicated.
- C. Painted Steel Sheet: ASTM A 366 (commercial quality) cold rolled steel sheet or ASTM A 570, Grade 33 (structural quality) hot-rolled steel sheet, as standard with manufacturer for type of anchor indicated, coated after fabrication with manufacturers standard, fast-curing, lead-free "universal primer" resistant to normal atmospheric corrosion.
 1. Use painted steel framing anchors for rough carpentry not exposed to weather, in ground contact, or in area of high relative humidity.

2.10 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; in rolls of 50 feet or 100 feet in length.

- B. Water Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbonate (IPBC) as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Install permanent grounds of dressed, preservative treated, key-bevelled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.3 WOOD FURRING

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

1. Firestop furred spaces on walls at each floor level and at ceiling line of top story, with wood blocking or noncombustible materials, accurately fitted to close furred spaces.
- B. Furring to Receive Plywood Paneling: Install 1-inch by 3-inch furring at 2 feet o.c., horizontally and vertically. Select furring for freedom from knots capable of producing bent-over nails and resulting damage to paneling.
- C. Furring to Receive Gypsum Drywall: Install 1-inch by 2-inch furring at 16 inches o.c., vertically.
- D. Furring to Receive Plaster Lath: Install 1-inch by 2-inch furring at 16 inches o.c., vertically.
- E. Suspended Furring: Install suspended furring members of size and spacing indicated, including hangers and attachment devices. Level to a tolerance of 1/8 inch in 10 feet, except 1/4 inch in 10 feet for thick-coat plaster work.

3.4 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with N.F.P.A. "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install framing composed of engineered wood products to comply with manufacturer's directions.
- C. Install framing members of size and spacing indicated.
- D. Anchor and nail as shown, and to comply with the following:
 1. National Evaluation Report No. NER-272 for pneumatic or mechanical driven staples, P-Nails, and allied fasteners.
 2. Published requirements of manufacturer of metal framing anchors.
 3. "Recommended Nailing Schedule" of referenced framing standard and with N.F.P.A. "National Design Specifications for Wood Construction."
 4. "Fastening Schedule," of the International Building Code 2000.
- E. Do not splice structural members between supports.
- F. Firestop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are not automatically provided by the framing system used, use closely fitted wood blocks of nominal 2-inch-thick lumber of the same width as framing members.

3.5 STUD FRAMING

- A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Install single bottom plate and double top plates using 2-inch-thick members whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.
 1. For exterior walls install 2-inch by 6-inch wood studs spaced 16 inches o.c.
 2. For interior partitions and walls install 2-inch by 4-inch wood studs spaced 16 inches o.c.

- B. Construct corners and intersections with not less than 3 studs. Install miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items, and trim.
 - 1. Install continuous horizontal blocking row at mid-height of single-story partitions over 8 feet high and at midpoint of multi-story partitions, using 2-inch thick members of same width as wall or partitions.
- C. Frame openings with multiple studs and headers. Install nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.
 - 1. For nonbearing partitions, install double-jamb studs and headers not less than 4 inches deep for openings 3 feet and less in width, and not less than 6 inches deep for wider openings.
 - 2. For load-bearing partitions, install double-jamb studs for openings 6 feet and less in width, and triple-jamb studs for wider openings. Install headers of depth shown, or if not shown, as recommended by N.F.P.A. "Manual for House Framing."
- D. Install diagonal bracing in stud framing of exterior walls, except as otherwise indicated. Brace both walls at each external corner, full story height, at a 45 degree angle, using either a let-in 1 by 4 or 2 by 4 blocking or metal diagonal bracing. Omit bracing where following types of sheathing are indicated.
 - 1. Plywood sheathing or corner bracing, 4-feet-wide panels vertically.

3.6 FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 - 1. To wood bearing members by toe nailing or metal framing anchors.
- B. Fire-cut members built into masonry.
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4 feet.
- D. Do not notch in middle third of joists; limit notches to 1/6-depth of joist, 1/3 at ends. Do not bore holes larger than 1/3-depth of joist or locate closer than 2 inches from top or bottom. Install solid blocking (2 inches thick by depth of joist) at ends of joists unless nailed to header or bearing member.
- E. Lap members framing from opposite sides of beams, girders or partitions not less than 4 inches or securely tie opposing members together. Install solid blocking (2 inches thick by depth of joist) over supports.
- F. Anchor members paralleling masonry with 1/4-inch by 1-1/4-inch metal strap anchors spaced not more than 8 feet o.c. Extend anchors at least 4 inches into masonry, turn up 4 inches and extend

over and fasten to 3 joists.

- G. Under jamb studs at openings, install solid blocking between joist.
- H. Under non-load-bearing partitions, install double joists separated by solid blocking equal to depth of studs above.
 - 1. Install triple-joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- I. Install bridging of type indicated below between joists where nominal depth-to-thickness ratio exceeds 6, at intervals of 8 feet.
 - 1. Diagonal wood bridging formed from bevel cut nominal 1-inch by 4-inch lumber, double-crossed and nailed both ends to joists.
 - 2. Solid wood bridging 2 inches thick by depth of joist, end nailed to joist.
 - 3. Steel bridging installed to comply with bridging manufacturer's directions.

3.7 RAFTER AND CEILING JOIST FRAMING

- A. Ceiling Joists: Install ceiling joists with crown up and to comply with requirements specified above for floor joists. Face nail to ends of parallel rafters.
 - 1. Where principal ceiling joists are at right angles to rafters, frame as indicated with additional short joists from wall plate to first joist; nail to ends of rafters and to top plate and nail to long joists or anchor with framing anchors or metal straps. Install 1 by 8 or 2 by 4 stringers spaced 4 feet o.c. crosswise over principal ceiling joists.
- B. Rafters: Notch to fit exterior wall plates and toe nail or use special metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing (if any), and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 - 1. At valleys, install valley rafter of size shown, or if not shown, twice the thickness of regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafter.
 - 2. At hips, install hip rafters of size shown, or if not shown, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafters.
- C. Install collar beams (ties) as shown, or if not shown, install 1-inch by 6-inch boards between every third pair of rafters. Locate below ridge member, one-third of distance to ceiling joists. Cut ends to fit slope and nail to rafters.
- D. Install special framing as shown for eaves, overhangs, dormers and similar conditions, if any.

3.8 PARTICLEBOARD UNDERLAYMENT

- A. Install in compliance with the recommendations of the National Particleboard Association (NPA) for the type of subfloor indicated. Fill and sand gouges, gaps and chipped edges. Sand uneven joints flush.
 - 1. Nail underlayment to subflooring.
 - 2. Nail or staple underlayment to subflooring.
 - 3. Glue and nail underlayment to subflooring throughout.

3.9 GYPSUM SHEATHING

- A. General: Install gypsum board sheathing where shown. Fasten to exterior face of stud framing for exterior walls. Use 1-1/2-inch long, 11 gage galvanized roofing nails with 3/8-inch head or 15 gage, divergent point galvanized staples 1/2 inch wide by 1-1/2 inches long. Keep perimeter fasteners 3/8 inch from edges and ends of board units. Fit boards tightly against each other and around openings.

END OF SECTION 06 10 00

SECTION 06 19 20
PREFABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Metal Plate Connected Wood Trusses
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Structural Glued Laminated Timber."
 - 2. Division 6 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following products:
 - 1. Metal plate connectors
 - 2. Metal framing anchors
 - 3. Product data for truss components
- C. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.
- D. Shop drawings showing size, design values, materials and dimensional relationships of components as well as bearing and anchorage details.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Wood Products: Obtain each type of wood products from one source from a single manufacturer.
- B. To extent engineering design considerations are fabricator's responsibility, submit design analysis and test reports indicating truss performance characteristics. Comply with requirements. Provide shop drawings, which have been signed and stamped by a structural engineer licensed to practice in state where trusses are fabricated.
- C. Certification, signed by officer of fabricating firm, indicating trusses comply with project

requirements.

- D. Comply with N.F.P.A. National Design Specification and with TPI standard including “Quality Control Manual”, “Commentary and Recommendation for Handling and Erecting Wood Trusses”, “Commentary and Recommendations for Bracing Wood Trusses” and the following:

“Design Specification for Metal Plate Connected Wood Trusses”

1.5 DELIVERY, STORAGE, AND HANDLING

- 1. Handle and store trusses with care and to comply with TPI recommendations to avoid damage from bending, overturning or other cause.

PART 2 – PRODUCTS

2.1 LUMBER, GENERAL:

- A. Lumber Standards: Provide lumber S4S, S-Dry, unless otherwise indicates grade marked, complying with PS 20 and requirements indicated.
- B. Lumber Species: Any softwood, at Contractor’s option, graded with WWPA, WCPA, WCLB, SPIB or NLGA rules, which complies with other requirements.
- C. Lumber Grade: Any grade fulfilling requirements indicated.
- D. Stress Rating: Provide lumber, which has been graded or tested and certified to comply with stress rating indicating.

$$F_b = 1850 \text{ psi. } F_t = 1050 \text{ psi. } F_c = 1450 \text{ psi. } E = 1,800,000 \text{ psi.}$$

2.2 METAL CONNECTOR PLATES

- A. Metal Connector Plates: Metal as indicated, not less than 0.036” thick, coated thickness.
- B. Galvanized Sheet Steel: ASTM A 446, Grade A, G60.
- C. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591, Class C, with minimum structural quality equivalent to ASTM A 446, Grade A.
- D. Stainless Steel: ASTM A 167, Type 304, with minimum structural quality equivalent to ASTM A 446, Grade A.

2.3 METAL FRAMING ANCHORS

- A. Fasteners and Anchorages: Of size, type, material and finish suited to application shown and complying with applicable standards including FS FF-N-105 and FF-W-92, and ANSI B18.6.1.

2.4 FABRICATION

- A. Fabricate and assemble trusses to provide units of configuration indicated, with closely fitted joints and connectors plates securely fastened to wood members.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install miscellaneous steel connectors, anchors, and accessories.
- B. Plan and execute erection procedures so that close fit and neat appearance of joints and structure as a whole will not be impaired. When hoisting members into place, use padded or non-marring slings, and protect corners with wood blocking.
- C. Adequately brace members as they are placed to maintain safe position until full stability is provided.
- D. Install trusses to comply with TPI references standards and other indicated requirements.

END OF SECTION 06 19 20

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 09 93 00 - Staining and Transparent Finishing: Field finishing of cabinet exterior.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. AWI (QCP) - Quality Certification Program; Current Edition.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- F. BHMA A156.9 - Cabinet Hardware; 2020.
- G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
- H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 3. Include certification program label.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 3. Single Source Responsibility: Provide and install this work from single fabricator.
- B. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
6. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UPS

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. See Section 01 40 00 - Quality Requirements for additional requirements.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Breakroom Cabinets: Plastic laminate faced, Custom grade.
- D. Cabinets:
 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 3. Finish - Semi-Exposed Surfaces: Decorative laminate
 4. Finish - Concealed Surfaces: Manufacturer's option.
 5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 6. Door and Drawer Front Retention Profiles: Fixed panel.
 7. Casework Construction Type: Type A - Frameless.
 8. Interface Style for Cabinet and Door: Style 2 - Finish Inset; reveal overlay.
 9. Adjustable Shelf Loading: 40 psf.
 - a. Deflection: L/144.
 10. Cabinet Style: Flush overlay.
 11. Cabinet Doors and Drawer Fronts: Flush style.
 12. Drawer Side Construction: Multiple-dovetailed.
 13. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.03 PANEL CORE MATERIALS

- A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
 - 1. Grade: M-2; moisture resistance: MR10.
 - 2. Panel Thickness: 3/4 inch.
- B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
 - 1. Grade: 115; moisture resistance: MR10.
 - 2. Panel Thickness: 3/4 inch.

2.04 HARDWOOD PLYWOOD PANELS

- A. Hardwood Plywood: Plywood manufactured for nonstructural decorative applications; consisting of faces and backs applied to a variety of core types; comply with HPVA HP-1.
 - 1. Woodwork Quality Standard: Panels complying with specified woodwork quality standard.

2.05 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com/#sle.
 - 2. Wilsonart LLC: www.wilsonart.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.

2.06 COUNTERTOPS

- A. Provide pre-formed plastic laminate countertops with backsplash where indicated on drawings.

2.07 HARDWARE

- A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
 - 1. Hardware Types: As indicated on drawings.
 - 2. Product Grade: Grade 2.
- B. Metal Z-Shaped Wall Cabinet Support Clips: Paired, cleated, structural anchorage components applied to back of cabinets and walls for wall cabinet mounting.
 - 1. Material: Extruded Aluminum.
- C. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome or satin chrome finish, for nominal 1 inch spacing adjustments.
- D. Shelf Support Brackets: Fixed, L-shaped, corner reinforced, face-of-stud mounting.
 - 1. Materials: Formed steel shapes.
 - a. Finish: Manufacturer's standard, factory-applied, textured powder coat.
- E. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.
- F. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- G. Sliding Door Pulls: Circular shape for recessed installation, steel with satin finish.
- H. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- I. Cabinet Catches and Latches:
 - 1. Manufacturers:
 - a. Knappe & Vogt Manufacturing Company: www.knappeandvogt.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

- J. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Manufacturers:
 - a. Knappe & Vogt Manufacturing Company; Medium-Duty Drawer Slides:
www.knappeandvogt.com/#sle.
 - b. Knappe & Vogt Manufacturing Company; Heavy-Duty Drawer Slides:
www.knappeandvogt.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- K. Soft-Close, Door and Drawer Adjustable Dampers:
- L. Hinges: European style concealed type, steel with nickel-plated finish.

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 41 00

**SECTION 07 21 00
RIGID BOARD INSULATION (WALLS)**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Polyisocyanurate insulation for cavity wall applications.

1.02 RELATED SECTIONS

- A. Section 03300 - Cast In Place Concrete: Perimeter and under-slab insulation installation.
- B. Section 03300 - Cast In Place Concrete: Concrete base wall.
- C. Section 03400 - Pre-Cast Concrete: Pre-cast concrete base wall.
- D. Section 05400 - Cold Formed Metal Framing.
- E. Section 04210 - Clay Masonry: Brick facing.
- F. Section 04800 - Masonry Assemblies: Masonry base wall.
- G. Section 06100 - Rough Carpentry.
- H. Section 07260 - Vapor Retarders: Vapor retarder materials adjacent to insulation.
- I. Section 07270 - Air Barriers: Air seal materials adjacent to insulation.
- J. Section 09110 - Non-Structural Metal Framing.
- K. Section 09200 - Plaster and Gypsum Board.

1.03 REFERENCES

- A. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
- B. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- C. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- D. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.
- F. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
- G. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
- I. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- J. ASTM E 564 - Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings.
- K. ASTM E 2126 - Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings.
- L. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
- N. SBCRI Single Element Lateral Load Testing.
- O. UL 1715 - Fire Test of Interior Finish Material.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each finish product specified, two samples, minimum size 4 inches by 6 inches (102mm x 150 mm).

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- D. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, and insulation manufacturer's installation instructions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products per manufacturer's instructions until ready for installation.
- B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.07 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 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.

1.09 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Rmax Operating, LLC, which is located at: 13524 Welch Rd. ; Dallas, TX 75244-5227; Toll Free Tel: 800-527-0890; Tel: 972-387-4500; Fax: 972-387-4673; Email: request info (rmax@rmax.com); Web: www.rmax.com

- B. Rmax Operating, LLC; 13524 Welch Rd., Dallas, TX 75244. Toll Free Tel: 800-527-0890. Tel: 972-387-4500. Fax: 972-387-4673. Email: specs@rmax.com. Web: www.rmax.com .
- C. Rmax Operating, LLC; 210 Lyon Dr., Fernley, NV 89408. Toll Free Tel: 800- 762-9462. Tel: 775-575-4849. Fax: 775-575-5035. Email: specs@rmax.com. Web: www.rmax.com .
- D. Rmax Operating, LLC; 1649 S. Batesville Rd., Greer, SC 29650. Toll Free Tel: 800-845-4455. Tel: 864-297-1382. Fax: 864-234-7548. Email: specs@rmax.com. Web: www.rmax.com .
- E. Substitutions: Only Architect-approved products.
 - 1. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.02 CONTINUOUS INSULATION FOR WALLS

- A. Thermasheath-3: Closed-cell polyisocyanurate insulation with reinforced foil facer on each side.
 - 1. Density (Nominal) in accordance with ASTM D1622: 2.0 pcf.
 - 2. Compressive Strength in accordance with ASTM D1621: 20 psi.
 - 3. Flame Spread in accordance with ASTM E84: 75 or less.
 - 4. Smoke Developed in accordance with ASTM E84: 450 or less.
 - 5. Water Vapor Transmission in accordance with ASTM E96: Less than 0.3 perms.
 - 6. Water Absorption in accordance with ASTM C209: Less than 1 percent by volume.
 - 7. Dimensional Stability in accordance with ASTM D2126: Less than 2 percent linear change.
 - 8. Air Permeance in accordance with ASTM E2178: Less than 0.02 l/ssm.
 - 9. Thickness: 2.5 inches.
 - 10. Thermal Resistance (R): 16.7.

PART 3 - EXECUTION

3.01 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.

3.02 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

3.03 INSTALLATION

- A. install in accordance with manufacturer's instructions.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 21 00

This page intentionally left blank

**SECTION 07 21 13
CONTINUOUS INSULATION (ROOFS)**

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 CONTINUOUS INSULATION FOR ROOFS:

1. Multi-Max FA-3.

1.03 RELATED SECTIONS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 034116 - Precast Concrete Slabs.
- C. Section 054000 - Cold-Formed Metal Framing.

1.04 SECTION 061000 - ROUGH CARPENTRY.

- A. Section 072600 - Vapor Retarders.
- B. Section 072726 - Fluid-Applied Membrane Air Barriers .
- C. Section 075000 - Membrane Roofing.
- D. Section 092216.13 - Non-Structural Metal Stud Framing.
- E. Section 092523 - Lime Based Plastering.

1.05 REFERENCES

- A. AAMA 2605 - ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies.
- B. ASTM International (ASTM):
 1. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
 2. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 3. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
 4. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
 5. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 6. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 7. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 8. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
 9. ASTM E 564 - Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings.
 10. ASTM E 2126 - Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings.
 11. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials.
 12. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.06 SUBMITTALS

1.07 SUBMIT UNDER PROVISIONS OF SECTION 013000 - ADMINISTRATIVE REQUIREMENTS.

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.

- B. Verification Samples: For each finish product specified, two samples, minimum size 4 inches by 6 inches (102mm x 150 mm).

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Remodel mock-up area as required to produce acceptable work.
- D. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, and insulation manufacturer's installation instructions.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle products per manufacturer's instructions until ready for installation.

1.10 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.12 WARRANTY

- A. Insulation Warranty: At project closeout, provide to Owner an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Rmax Operating, LLC, which is located at: 13524 Welch Rd.; Dallas, TX 75244-5227; Toll Free Tel: 800-527-0890; Tel: 972-387-4500; Fax: 972-387-4673; Email: request info (rmax@rmax.com); Web: www.rmax.com
 - 1. Rmax Operating, LLC; 13524 Welch Rd., Dallas, TX 75244. Toll Free Tel: 800-527-0890. Tel: 972-387-4500. Fax: 972-387-4673. Email: specs@rmax.com. Web: www.rmax.com .
 - 2. Rmax Operating, LLC; 210 Lyon Dr., Fernley, NV 89408. Toll Free Tel: 800-762-9462. Tel: 775-575-4849. Fax: 775-575-5035. Email: specs@rmax.com. Web: www.rmax.com .
 - 3. Rmax Operating, LLC; 1649 S. Batesville Rd., Greer, SC 29650. Toll Free Tel: 800-845-4455. Tel: 864-297-1382. Fax: 864-234-7548. Email: specs@rmax.com. Web: www.rmax.com .
- B. Substitutions: Comparable products will be considered; must be approved by Architect during submittal process.

2.02 CONTINUOUS INSULATION FOR ROOFS

- A. Multi-Max FA-3: Closed-cell polyisocyanurate roof insulation with glass fiber / organic mat facer on each side.
 - 1. Compliance:
 - a. ASTM C1289 Type II, Class 1.
 - b. International Building Code (IBC) Section 2603, Foam Plastic.
 - c. ASHRAE 90.1.
 - d. Miami-Dade County Product Control Approved.
 - e. RR 25378, City of Los Angeles Research Report.
 - f. California Code of Regulations, Title 24.
 - g. Factory Mutual - Class 1 roofing per FM Standard 4470 (1.5 inches minimum Thickness). Multi-Max FA-3 is subject to the conditions of approval such as a roof insulation when installed as described in the current edition of the FMRC "Approval Guide." Refer to FM Approvals RoofNav for specific system details.
 - h. Underwriters Laboratories - UL listed and labeled as shown in UL Certifications Directory:
 - 1) Class A for External Flame - UL Standard 790.
 - 2) Class A for Internal Flame - UL Standard 1256.
 - 3) Fire Rated Roof/Ceiling Assemblies - UL Standard 263.
 - 2. Density (Nominal) in accordance with ASTM D1622: 2.0 pcf.
 - 3. Compressive Strength: ASTM D 1621 and ASTM C 1289, Type II, 20 psi minimum for Grade 2 and 25 psi for Grade 3.
 - 4. Flame Spread in accordance with ASTM E84: 25 to 60.
 - 5. Smoke Developed in accordance with ASTM E84: 75 to 160.
 - 6. Water Vapor Transmission in accordance with ASTM E96: Less than 1.5 perms.
 - 7. Water Absorption in accordance with ASTM C209: Less than 1 percent by volume.
 - 8. Dimensional Stability in accordance with ASTM D2126: Less than 2 percent linear change.
 - 9. Class 1 roof insulation per FM Standard 4450.
 - 10. Class A for external flame per UL Standard 790.
 - 11. Class A for internal flame per UL Standard 1256.
 - 12. Fire rated roof/ceiling assemblies per UL Standard 263.
 - 13. Service temperature: -40 degree F to +250 degree F (-38 degree C to 121 Degree C).
 - a. Thickness: 2.5 inches ea. (2 layers)(64mm).
 - 1) Long Term Thermal Resistance (LTTR): 14.4.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
 - 1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 21 13

SECTION 07 27 26.01
FLUID-APPLIED MEMBRANE AIR BARRIER

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. General Conditions, Supplementary Conditions, Instructions to Bidders and Division One General Requirements shall be read in conjunction with and govern this section.
- B. This Specification shall be read as a whole by all parties concerned. Each Section may contain more or less than the complete Work of any trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their Work.

1.02 DESCRIPTION

- A. Supply labor, materials and equipment to complete the Work as shown on the Drawings and as specified herein to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundations.
 - 3. Seismic and expansion joints.
 - 4. Openings and penetrations of window and door frames, store front, curtain wall.
 - 5. Piping, conduit, duct and similar penetrations.
 - 6. Masonry ties, screws, bolts and similar penetrations.
 - 7. All other air leakage pathways in the building envelope.
- B. Materials and installation methods of the primary water-resistive vapor permeable air barrier membrane system and accessories.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide an asphalt base water-resistive vapor permeable air barrier membrane system constructed to perform as a continuous air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane system shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air sealant materials at such locations, changes in substrate, perimeter conditions and penetrations. Joints and seals 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 resist positive and negative pressure from wind, stack effect and mechanical ventilation.
- B. Water-resistive vapor permeable air barrier membrane system to be applied to the minimum uniform thickness specified and as utilized in the referenced Standard Test Methods.

1.04 RELATED SECTIONS

- A. Concrete: Section 03 30 00
- B. Masonry: Section 04 05 00
- C. Plywood Sheathing: Section 06 10 00
- D. Insulation: Section 07 21 00
- E. Roofing: Section 07 50 00
- F. Sealants: Section 07 90 00
- G. Flashing: Section 07 60 00
- H. Openings: Section 08 06 00
- I. Gypsum Sheathing: Section 09 20 00

1.05 REFERENCES

- A. The following standards are applicable to this section:

1. ASTM E 2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
2. ASTM E 2178: Standard Test Method for Air Permeance of Building Materials.
3. ASTM E 283: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
4. ASTM E 96: Water Vapor Transmission of Materials.
5. AATCC 127 Water Resistance Hydrostatic Pressure Test.
6. ASTM D 1970: Sealability.
7. ICC-ES AC 212: Acceptance Criteria for Water Resistive Coatings.
8. ASTM E 84: Test for Surface Burning Characteristics of Building Materials

1.06 SUBMITTALS

- A. Submit documentation from an approved independent testing laboratory certifying the air leakage rates of the air barrier membranes assembly, including primary membrane, primer and sealants have been tested to meet ASTM E 2357.
- B. Submit documentation from an approved independent testing laboratory certifying the air leakage and vapor permeance rates of the air barrier membranes, including primary membrane and transition sheets, exceed the requirements of the Massachusetts Energy Code and in accordance with ASTM E 2178.
 1. Test report submittals shall include test results on porous substrate and include sustained wind load and gust load air leakage results.
- C. Submit manufacturers' current product data sheets for the air barrier membrane system.

1.07 QUALITY ASSURANCE

- A. Submit document stating the applicator of the primary water-resistive vapor permeable air barrier membranes specified in this section is qualified by the manufacturer as suitable for the execution of the Work.
- B. Perform Work in accordance with manufacturer's written instructions and this specification.
- C. Maintain one copy of manufacturer's written instructions on site.
- D. Allow access to Work site by the air barrier membrane manufacturer's representative.
- E. Components used shall be sourced from one manufacturer, including sheet membrane, water-resistive vapor permeable air barrier sealants, primers, mastics, and adhesives.
- F. Single-Source Responsibility:
 1. Obtain water-resistive vapor permeable air barrier materials from a single manufacturer regularly engaged in manufacturing the product.
 2. Provide products which comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

1.08 MOCK-UP

- A. Construct mock-up in accordance with Section 01 43 39 – Mock-ups.
- B. Provide mock-up of water-resistive vapor permeable air barrier materials under provisions of Section 01 33 23 - Shop Drawings, Product Data and Samples.
- C. Where directed by architect, construct typical exterior wall panel, 6 foot long by 6 foot wide, incorporating substrate, window frame, attachment of insulation and showing air barrier membrane application details.
- D. Allow 48 hours for inspection of mock-up by architect before proceeding with air barrier work. Mock-up may remain as part of the Work.
- E. Test mock-up for air and water infiltration to conform with Section 01400 - Quality Control, in accordance with ASTM E 783 and ASTM E 1105.

1.09 PRE-INSTALLATION CONFERENCE

- A. Contractor shall convene one week prior to commencing Work of this section.
- B. Ensure all contractors responsible for creating a continuous plane of air tightness are present.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Refer to current Product MSDS for proper storage and handling.
- B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- C. Store materials on end in original packaging. Protect rolls from direct sunlight until ready for use.
- D. Store water-resistive vapor permeable air barrier membranes, adhesives and primers at temperatures of 40 degrees F and rising.
- E. Keep solvent away from open flame or excessive heat.
- F. Wasted Management and Disposal
 - 1. Separate and recycle waste materials in accordance with Section [01355 - Waste Management and Disposal], and with the Waste Reduction Work Plan
- G. Contractor to verify compliance for Volatile Organic Compounds (VOC) limitations of products to comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

1.11 CO-ORDINATION

- A. Ensure continuity of the specified membranes throughout the scope of this section.
 - 1. Air barrier membrane to include liquid applied water-resistive vapor permeable air barrier, transition membranes and sealant at penetrations.
 - 2. Drainage plane to include water resistive barrier and flexible flashings to exterior.

1.12 ALTERNATES

- A. Submit request for alternates in accordance with Section 01 25 00 – Substitution Procedures.
- B. Submit requests for alternates a minimum of ten (10) working days prior to bid date
- C. Alternate submission to include:
 - 1. Evidence that alternate materials meet or exceed performance characteristics of Product requirements as well as documentation from an approved independent testing laboratory certifying the air leakage rates and vapor permeance rates of the air barrier membranes, including primary membrane and transition sheets, meet the requirements of ASTM E 2357, the Massachusetts Energy Code and in accordance with ASTM E 2178.
 - 2. Manufacturer's complete set of details for air barrier membrane system showing a continuous plane of air tightness throughout the building envelope.
- D. Acceptable alternates will be confirmed by addendum. Substitute materials not approved in writing prior to bid date shall not be permitted for use on this project.

1.13 WARRANTY

- A. Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Air barrier membrane components and accessories must be obtained as a single-source to ensure total system compatibility and integrity.
 - 1. Acceptable system by Sika Corp
 - a. 201 Polito Avenue Lyndhurst, NJ

- b. 800 933 Sika (7452)
- c. www.Sikausa.com

2.02 MEMBRANES (BASIS-OF-DESIGN)

- A. Primary vapor permeable air and rain barrier membrane for temperatures above 40 degrees F and rising shall be Sikagard® 530 Liquid Applied Acrylic Vapor Permeable Air Barrier by Sika Corp, a low VOC one component elastomeric acrylic membrane that may be trowel, brush, roller or spray applied. Membrane shall have the following physical properties:
 - 1. Color: Yellow
 - 2. Air permeability: 0.0001CFM/ft2 @ 1.6 lbs/ft2 to ASTM E 2178.
 - 3. Tested to ASTM E 2357 for Air Leakage of Air Barrier Assemblies
 - 4. Water vapor permeance (21 mil dry thickness): 11 perms to ASTM E 96 Method B
 - 5. Nominal wet film thickness: 40 mils
 - 6. Recycled Content by weight: 25%
 - 7. VOC: <50g/l
 - 8. Fastener Sealability: Pass to ASTM D 1970
 - 9. Water Resistance: Pass to AATCC 127
 - 10. May be exposed for up to 6 months
 - 11. FSI of 20 & SDI of 25 to ASTM E 84
- B. Self-adhering membrane for all window jambs, headers, door openings, inside and outside corners, joint treatment and other transitions shall be SikaMultiSeal® 515 Self-Adhered Transition Seam Tape by Sika Corp, a self-adhering polyester-backed, synthetic butyl rubber based adhesive membrane for wall construction, specifically designed to be water resistant. Membrane shall have the following physical properties:
 - 1. Membrane Thickness: 0.0394 inches (40 mils)
 - 2. Low temperature flexibility: -30 degrees F
 - 3. Elongation: 500% to ASTM D 412-modified

2.03 LIQUID SEAM AND PENETRATION SEALANTS

- A. Liquid seam sealant shall be Sikaflex® 110 Liquid Seam Sealant by Sika Corp, a moisture cure, medium modulus polyether sealing compound having the following physical properties:
 - 1. Compatible with air barrier, roofing and waterproofing membranes and substrate,
 - 2. Set Time: 1 hour @ 72 degrees, 40% RH
 - 3. Solids: 100%
 - 4. Elongation: 200% to ASTM D 412/C1135
 - 5. Joint Movement 12.5%+/- ASTM C 719
 - 6. Seals construction joints
- B. Penetration sealant shall be Sikasil WS 290 by Sika Corp, a one-part, neutral-curing, ultra low-modulus silicone sealant that cures to a durable, flexible building sealant and having the following physical properties:
 - 1. Compatible with air barrier, roofing and waterproofing membranes and substrate,
 - 2. Tensile Properties (ASTM D-412) at 21 days
 - 3. Tensile Stress: 165 psi (1.14 MPa)
 - 4. Elongation at Break: 1200%
 - 5. Modulus of Elasticity: 100% 42 psi (0.29 MPa)

2.04 PRIMER AND SURFACE CONDITIONER

- A. Primer for self-adhering transition and flashing membrane at all temperatures shall be Sikagard® 510 Transition Seam Tape Primer by Sika Corp, a high tack adhesive primer, quick setting, having the following physical properties:
 - 1. Color: White,
 - 2. Solids by weight: 37%,

3. Drying time (initial set): 30 minutes.
- B. Surface conditioner for self-adhering transition and flashing membrane at temperatures above 40 degrees F shall be Sikagard® 530 Liquid Air Barrier Membrane having the following physical properties:
 1. Color: Yellow,
 2. Solids by weight: 64%,
 3. Application Rate: 160 sq.ft/gallon to a uniform wet film thickness of 10 mils.
 4. Drying time (initial set): 60 minutes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify architect in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.
- B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints flush.
- C. Where curing compounds are used they must be clear resin based without oil, wax or pigments.
- D. Do not proceed with application of air barrier membrane when rain is expected within 24 hours.
- E. Condition materials to room temperature prior to application to facilitate handling.

3.02 SURFACE PREPARATION

- A. Ensure all preparatory Work is complete prior to applying primary air barrier membrane.
- B. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.
- C. Mechanical penetrations [piping, conduit & vents] shall be secured solid and fastened into solid backing.
- D. New concrete should be cured for no less than 14 days prior to the application of primer and self-adhered transition seam tape.
- E. Thoroughly mix primary vapor permeable air and rain barrier membrane prior to installation.

3.03 INSTALLTION OF AIR BARRIER SYSTEM

- A. JOINT TREATMENT
 1. Seal joints ¼ inch and less between panels of exterior grade gypsum, DensGlass Gold, plywood, OSB or cementitious panels with liquid seam sealant.
 - a. Fill joint between sheathing with approved liquid seam sealant ensuring contact with all edges of sheathing board.
 2. Seal gaps and voids or irregular joints greater than ¼ inch between panels of exterior grade gypsum, DensGlass Gold, plywood, OSB or cementitious panels with a strip of self-adhering transition membrane lapped a minimum of 3 inches on both sides of the joint.
 - a. Prepare and/or prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane.
 - b. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane.
- B. INSIDE AND OUTSIDE CORNERS
 1. Seal inside and outside corners with a strip of self-adhering transition membrane extending a minimum of 3 inches on either side of the corner detail.
 - a. Prepare and/or prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane.

- b. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane.
 - c. Roll all laps and membrane with a counter top roller to ensure seal.
- C. CRACK TREATMENT – MASONRY AND CONCRETE
 - 1. Seal cracks $\frac{1}{4}$ inch and less in masonry and concrete with liquid seam sealant applied over the crack.
 - a. Fill joint between sheathing with approved liquid seam sealant ensuring contact with all edges of sheathing board.
 - 2. Seal cracks and voids in masonry and concrete greater than $\frac{1}{4}$ inch with a strip of self-adhering transition membrane lapped a minimum of 3 inches on both sides of the joint.
 - a. Prepare and/or prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane.
 - b. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane.
 - c. Roll all laps and membrane with a counter top roller to ensure seal.
- D. TRANSITION AREAS
 - 1. Tie-in to structural beams, columns, floor slabs and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials as indicated in drawings with self-adhering transition membrane.
 - a. Prime surfaces as per manufacturers' instructions and as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane.
 - b. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Provide minimum 3 inch lap to all substrates.
 - c. Ensure minimum 2 inch overlap at all end and side laps of membrane.
 - d. Roll all laps and membrane with a counter top roller to ensure seal.
 - 2. Tie-in to PVC roofing Systems as indicated in drawings with specified liquid acrylic air barrier membrane.
 - a. Apply by brush, roller or spray a complete and continuous unbroken film of liquid vapor permeable air and rain barrier membrane to the top of the wall and/or roof parapet.
 - b. Allow liquid acrylic vapor permeable air and rain barrier membrane to fully dry.
 - c. Align and position roof flashing & transition membrane over the outside face of the wall and extend a minimum 3 inch to lap over air barrier membrane and wall substrate.
 - d. Secure PVC roofing membrane with acceptable termination bar as detailed.
- E. WINDOWS AND ROUGH OPENINGS
 - 1. Wrap jamb of rough openings with specified self-adhering transition membrane as detailed.
 - 2. Extend specified self-adhering transition membrane into rough window openings sufficient to provide a connection to interior vapor retarder.
 - a. Prepare and/or prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane.
 - b. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all side laps and minimum 3 inches overlap at all end laps of membrane.
- F. PRIMARY AIR BARRIER
 - 1. Apply by brush, roller, spray or flat trowel a complete and continuous unbroken film of liquid vapor permeable air and rain barrier membrane.

- a. For temperatures above 40 degrees F and rising, apply one component acrylic water-resistive vapor permeable air barrier membrane at a rate of 40 sq.ft/gallon to a uniform wet film thickness of 40 mils.
2. Spray apply or brush around all projections and penetrations ensuring a complete and continuous air barrier membrane.
3. Allow air barrier membrane to dry as per manufacturers recommendations prior to placement of cladding materials.
4. Subject to porosity of substrate, recommend to back roll spray applications.

3.04 APPLICATION OF PENETRATION SEALANT

- A. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the primary vapor permeable air and rain barrier membrane and around the perimeter edge of membrane terminations at window and door frames with specified penetration sealant.
- B. Seal the leading edge of membrane terminations and reverse laps.

3.05 FIELD QUALITY CONTROL

- A. Make notification when sections of work are complete to allow review prior to covering water-resistive vapor permeable air barrier system.
- B. Owner to engage independent consultant to observe substrate and membrane installation prior to placement of cladding systems and provide written documentation of observations.

3.06 INSTALLATION OF INSULATION

- A. Co-ordinate with Cavity Wall Insulation Section 07 27 00 for insulating materials.

3.07 PROTECTION

- A. Damp substrates must not be inhibited from drying out. Drying time vary depending on interior and exterior temperature, and interior and exterior relative humidity. Do not expose the backside of the substrate to moisture or rain.
- B. Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane. Protect uncured air barrier Work against wet weather conditions for a minimum of 24 hours. Protect air barrier membrane from damage and inclement weather during the construction phase.
- C. Air barrier membranes are not designed for permanent exposure. Good practice calls for covering as soon as possible. Membrane exposure to UV not to exceed 6 months.

END OF SECTION 07 27 26.01

This page intentionally left blank

SECTION 07 30 11
ROOFING UNDERLAYMENT, HIGH-TEMPERATURE

PART 1 — GENERAL

1.01 SUMMARY

- A. This Section specifies a self-adhering sheet membrane used as underlayment for sloped roofs.
 - 1. High temperature application, 260F resistance, Grace Ice & Water Shield® HT.

1.02 RELATED SECTIONS: REFER TO THE FOLLOWING SPECIFICATION SECTIONS FOR COORDINATION:

- A. Section 061000 - Rough Carpentry.
- B. Section 073113 - Asphalt Shingles.
- C. Section 073116 - Metal Shingles.
- D. Section 073119 - Mineral-Fiber Cement Shingles.
- E. Section 073126 - Slate Shingles.
- F. Section 073129 - Wood Shingles and Shakes.
- G. Section 073200 - Roof Tiles.
- H. Section 076100 - Sheet Metal Roofing.
- I. Referenced Standards: Comply with the requirements of the following standards published by ASTM International to the extent referenced in this section.
- J. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
- K. ASTM D461 - Standard Test Methods for Felt.
- L. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
- M. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- N. ASTM D3767 - Standard Practice for Rubber—Measurement of Dimensions.
- O. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- P. ASTM G90 – EMMAqua test.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.
- B. Manufacturer: Minimum 10 years experience producing roofing underlayment.
- C. Installer: Minimum 2 years experience with installation of similar underlayment.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Protect from damage.
- B. Cover materials and store in dry condition between temperatures of 40 and 90 degrees F (5 and 32 degrees C). Use within one year of date of manufacture. Do not store at elevated temperatures as that will reduce the shelf life of the product.

PART 2 — PRODUCTS

2.01 MANUFACTURER

- A. Manufacturer: GCP Applied Technologies, Inc., 62 Whittemore Avenue, Cambridge, MA 02140, Toll Free 866-333-3726, www.gcpat.com.

2.02 MATERIALS

- A. Self-Adhering Sheet Membrane Roof Underlayment: Provide Grace Ice and Water Shield HT by GCP Applied Technologies, Inc with the following characteristics:
1. Material: Cold applied, self adhering membrane composed of an innovative and proprietary rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the high performance film with UV barrier properties.
 2. Membrane Thickness: 40 mils (1.02 mm) per ASTM D3767 Method A.
 3. Membrane Tensile Strength: MD 33 lbf/in, CD 31 lbf/inch per ASTM D412 Die C Modified.
 4. Membrane Elongation: 250% per ASTM D412 Die C Modified.
 5. Low Temperature Flexibility: Unaffected at -20 degrees F (-29 degrees C) per ASTM D1970.
 6. Adhesion to Plywood: 5.0 lb/in. width (876 N/m) per ASTM D903.
 7. Maximum Permeance: 0.05 perms (2.9 ng/sgms Pa) per ASTM E96.
 8. Maximum Material Weight Installed: 0.22 pounds/sqft (1.1 kg/sqm) per ASTM D461.
 9. Service Temperature: 260 degrees F (115.6 degrees C) per ASTM D1204
 10. Compatibility: Suitable for use under all types of sloped roofing with the exception high altitude climates where zinc, copper or Cor-Ten roof coverings are used.
 11. Adhesive: Rubberized asphalt adhesive containing post-consumer recycled content, contains no calcium carbonate, sand or fly ash.
 12. Exposure: Can be left exposed for a maximum of 120 days from date of installation per ASTM G90 – EMMAqua test.
 13. Primer: Water-based Perm-A-Barrier WB Primer by GCP Applied Technologies, Inc.
 14. Code and Standards Compliance: Grace Ice and Water Shield HT meets the following requirements:
 - a. ASTM D1970.
 - b. ICC-ES ESR-3121, per AC 48 Acceptance Criteria for Roof Underlayments used in Severe Climate Areas.
 - c. Underwriters Laboratories Inc. R13399 - Class A fire classification under fiber-glass shingles and Class C under organic felt shingles (per ASTM E108/UL 790).
 - d. Underwriters Laboratories Inc. Classified Sheathing Material Fire Resistance Classification with Roof Designs: P225, P227, P230, P237, P259, P508, P510, P512, P514, P701, P711, P717, P722, P723, P732, P734, P736, P742, P803, P814, P818, P824
 - e. Miami-Dade County Code Report NOA #15-0728.11
 - f. Florida State Approval Report No. FL289-R3
 - g. CCMC Approval No. 13671-L

PART 3 — EXECUTION

3.01 EXAMINATION

- A. Prior to start of installation, inspect existing conditions to ensure surfaces are suitable for installation of roofing underlayment. Verify flashing has been installed. Starting work indicates installers acceptance of existing conditions.

3.02 INSTALLATION

- A. Installation: Install roofing underlayment on sloped surfaces at locations indicated on the Drawings, but not less than at hips, ridges, eaves, valleys, sidewalls and chimneys, and surfaces over interior space within 36 inches (914 mm) from the inside face of the exterior wall. Strictly comply with manufacturer's installation instructions including but not limited to the following:
1. Schedule installation such that underlayment is covered by roofing within the published exposure limit of the underlayment.
 2. Do not install underlayment on wet or frozen substrates.
 3. Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.
 4. Remove dust, dirt, loose materials and protrusions from deck surface.
 5. Install membrane on clean, dry, continuous structural deck. Fill voids and damaged or unsupported areas prior to installation.
 6. Prime concrete and masonry surfaces using specified primer at a rate of 500-600 square feet per gallon (12-15 sqm/L). Priming is not required for other suitable clean and dry surfaces.
 7. Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Apply the membrane in valleys before the membrane is applied to the eaves. Following placement along the eaves, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.
 8. Side laps minimum 3-1/2 inches (89 mm) and end laps minimum 6 inches (152 mm) following lap lines marked on underlayment.
 9. Patch penetrations and damage using manufacturer's recommended methods.

3.03 CLEANING AND PROTECTION

- A. Protection: Protect from damage during construction operations and installation of roofing materials. Promptly repair any damaged or deteriorated surfaces.
- B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired in the opinion of the Architect.
- C. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protective film and reclean as necessary immediately before final acceptance.

END OF SECTION 07 30 11

This page intentionally left blank

**SECTION 07 41 13
METAL ROOF PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate-coated metal roof panels.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry: Wood framing and sheathing.
- B. Section 07 62 00 – Sheet Metal Flashing and Trim: Metal flashing.
- C. Section 07 72 00 – Roof Accessories: Roof ventilators.
- D. Section 07 92 00 – Joint Sealants: Field-applied sealants.

1.03 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME) (www.asme.org):
 - 1. ANSI/ASME B18.6.1 – Wood Screws (Inch Series).
 - 2. ANSI/ASME B18.6.4 – Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws, Inch Series.
- B. ASTM International (ASTM) (www.astm.org):
 - 1. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 792/A 792M – Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 3. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM D 226/D 226M – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - 5. ASTM D 1970/D 1970M – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 6. ASTM E 108 – Standard Test Methods for Fire Tests of Roof Coverings.
- C. ICC Evaluation Service (www.icc-es.org):
 - 1. ICC-ES Evaluation Report ESR-2901 – DECRA Shake (Batten Installation).
- D. International Organization for Standardization (ISO) (www.iso.org):
 - 1. ISO 9001:2015 – Quality management systems – Requirements.
 - 2. ISO 14001:2015 – Environmental management systems – Requirements with guidance for use.
- E. UL (www.ul.com):
 - 1. UL 790 – Standard for Standard Test Methods for Fire Tests of Roof Coverings.
 - 2. UL 2218 – Standard for Impact Resistance of Prepared Roof Covering Materials.

1.04 PREINSTALLATION MEETINGS

- A. Convene preinstallation meeting 1 week before start of installation of roof panels.
- B. Require attendance of parties directly affecting the Work of this Section, including Contractor, Architect, installer, and manufacturer's representative.
- C. Review the Following:
 - 1. Materials.
 - 2. Preparation.
 - 3. Installation.
 - 4. Adjusting.
 - 5. Cleaning.
 - 6. Protection.

7. Coordination with other Work.

1.05 SUBMITTALS

- A. Submittals: Comply with Division 01.
- B. Product Data: Submit manufacturer's product data, including preparation and installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, fabrication, flashing, fasteners, finish, options, and accessories.
- D. Samples: Submit manufacturer's sample of roof panels.
 - 1. Sample Size: Minimum 6 inches by 6 inches.
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- F. Product Evaluation Reports: Submit manufacturer's product evaluation reports from accredited evaluation service.
- G. Manufacturer's Project References: Submit manufacturer's list of 10 successfully completed roof panel projects of comparable size and scope to this Project, including project names and locations, name of architects, and type and quantity of roof panels furnished.
- H. Installer's Project References: Submit installer's list of 5 successfully completed roof panel projects of comparable size and scope to this Project, including project names and locations, name of architects, and type and quantity of roof panels installed.
- I. Warranty Documentation: Submit manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer is regularly engaged in the manufacturing of roof panels of similar type to that specified for a minimum of 10 years.
 - 2. Certified Company:
 - a. ISO 9001:2015.
 - b. ISO 14001:2015.
- B. Installer's Qualifications:
 - 1. Installer regularly engaged in installation of roof panels of similar type to that specified for a minimum of 5 years.
 - 2. Use persons trained for installation of roof panels.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.
 - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - 3. Store materials in clean, dry area indoors.
 - 4. Do not store materials directly on the floor or ground.
 - 5. Protect materials and finish during storage, handling, and installation to prevent damage.

1.08 WARRANTY

- A. Warranty Period:
 - 1. Multi-family Residential, Non-residential: 50-year limited.
 - a. Wind: Resist blow-off in wind speed up to 120 mph.

- b. Hail: Resist hail stone penetration, cracks, and splits. Hail stone size limit: 2.5"

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: DECRA Roofing Systems, Inc., 1230 Railroad Street, Corona, California 92882. Toll Free 877-463-3272. Phone 951-272-8180. Fax 951-272-4476. www.decra.com. info@decra.com.
- B. Substitutions: Comply with Division 01.
- C. Single Source: Provide materials from single manufacturer.

2.02 MATERIALS

- A. Basis-of-Design Product: DECRA Roofing Systems, Inc. "Shake XD" aggregate-coated metal roof panels.
- B. Roof Panels: DECRA "Shake XD" interlocking panels, resembling heavy-weight dimensional roofing shakes.
 - 1. Material: Pre-corrugated, pressure-formed, aluminum-zinc alloy-coated steel, ASTM A 792/A 792M, with multiple vertical ribs forming 2 flat steps, each of which have raised and lowered pan sections.
 - 2. Thickness: 26 gauge, 0.0179 inch.
 - 3. Finish: Ceramic-coated, colored-stone chip finish.
 - 4. Color: As selected by Architect from Manufacturer's Full Range.
 - 5. Dimensions:
 - a. Overall Panel Size: 14-1/8 inches wide by 52-1/8 inches long.
 - b. Installed Panel Exposure: 12-3/8 inches wide by 49-7/8 inches long.
 - c. Side Panel Laps: 2-1/2 inches.
 - d. Panel Leading Edges Bent Down: 1/2 inch; provides overlap for weather protection and adjoining to prior roof panels course.
 - 6. Installed Weight: 150 pounds per 100 sq feet.
 - 7. Recycled Steel Content: Maximum 30 percent.
 - 8. Non-Combustible, ASTM E 108, UL 790: Class A.
 - 9. Impact Resistance, UL 2218: Class 4.
 - 10. ICC-ES Evaluation Reports:
 - a. Direct-to-Roof Deck Installation: ESR-1754.
 - 11. Florida Building Code Approval:
 - a. Direct-to-Roof Deck Installation: FL9759-R10.
 - 12. Miami-Dade County Florida Building Code Approval:
 - a. Direct-to-Roof Deck Installation: NOA No. 23-0207.04.
- C. CCMC – National Building Code of Canada Approval:
 - 1. Direct-to-Roof Deck Installation: 13551-R.
- D. Flashing (Direct-to-Roof Deck Installation):
 - 1. Valley: DECRA "XD Valley" aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed into valley with stone-coated valley cap.
 - b. Thickness: 26 gauge, 0.0179 inch.
 - c. Finish: Match upper-exposed stone-coated surface of valley cap to shingle material.
- E. Flashing (Batten Installation)
 - 1. Valley: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Thickness: 26 gauge, 0.0179 inch.
 - 2. Side Flashing: DECRA "Side Flashing" aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.

- a. Pressure formed to flash vertical roof surface transitions.
 - b. Thickness: 26 gauge, 0.0179 inch.
 - c. Finish: Ceramic-coated, colored-stone chip finish to match roofing material.
3. Roof-to-Wall Flashing: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed to flash vertical roof surface transitions.
 - b. Thickness: 26 gauge, 0.0179 inch.
 - c. Finish: Match color to exterior finish.
4. Pipe Jack Flashing:
 - a. Material: Galvanized or aluminum-zinc alloy-coated steel, ASTM A 792/A 792M.
 - b. Thickness: 26 gauge, 0.0179 inch.
 - c. Finish: Clean, prime, and paint to match roof material.
5. Underpan: DECRA "Shake XD Underpan" aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed to counter flash roof penetrations matching roof panel material profile.
 - b. Thickness: 26 gauge, 0.0179 inch.
6. Fascia Metal: DECRA "Fascia Metal" aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed angle installed at first batten to cover build up.
 - b. 3.5 inches, 26 gauge, 0.0179 inch.
 - c. Finish: Ceramic-coated, colored-stone chip finish to match roofing material.
7. Hip and Ridge: DECRA "Shake XD Hip & Ridge" covers, fasciae, drips, rakes, and other trim required, matching shingle material, color, and finish.
 - a. Hips/Ridges and Rakes: DECRA "Shake XD Hip & Ridge" aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - b. Pressure formed to match roofing material.
 - c. Thickness: 26 gauge, 0.0179 inch.
 - d. Finish: Color and finish to be applied along the hips, ridges, and rakes.

2.03 ACCESSORIES

- A. Timber Battens: [Nominal 1 by 4 inch standard-grade counter-battens, as needed, for re-roof applications.] [Nominal 2 by 2 inch standard grade.]
 1. Fasteners: Nails, minimum 16d smooth, 3-1/4 inches (83 mm) long.
- B. Steel Battens: Minimum 20 gauge, ASTM A 653/A 653M galvanized steel, hat channels.
 1. Fasteners: Screws, minimum No. 8, 2 inches (51 mm) long, hot-dip galvanized.
- C. Sheet Metal Materials: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M, Class AZ50 coating designation; minimum Grade 37.
- D. Felt Underlayment: ASTM D 226/D 226M, Type I, No.15 or ASTM D 226/D 226M, Type II, No.30, non-perforated, asphalt-saturated organic felt.
- E. Perimeter Underlayment for Ice Dam Protection:
 1. Self-adhering, polymer-modified, bituminous sheet underlayment; 40 mils (0.04 inch) thick; ASTM D 1970/D 1970M.
 - a. Provide primer when recommended by underlayment manufacturer.
- F. Sealant:
 1. One-part elastomeric roofing-grade sealant, ASTM C 920.
 2. Exposed Sealant: Color to match roof panels.
- G. Fasteners:
 1. Screws:
 - a. Wood Screws: ANSI/ASME B18.6.1.
 - b. Sheet Metal Screws: ANSI/ASME B18.6.4.

- c. Corrosion resistant.
- d. Minimum No. 9.
- e. Length: Sufficient length to penetrate substrate 1/2 inch minimum.
- f. Color: Silver or color coordinated to match roof panels.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate to receive roof panels.
- B. Verify surfaces to support roof panels are clean, dry, square, sound, stable, rigid, and capable of supporting the weight.
- C. Notify Architect of conditions that would adversely affect installation or subsequent use.
- D. Do not begin preparation or installation until unacceptable conditions are corrected.

3.02 PREPARATION

- A. Prepare substrate in accordance with manufacturer's instructions.
- B. Clean substrate of projections and substances detrimental to roof panels.
- C. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with roofing nails.
- D. Inspect and verify roof framing spacing and installation is straight, true, and ready for installation of roof panels.
- E. Coordinate installation of roof panels with flashing and other adjoining work to ensure proper sequencing.
- F. Do not install roof panels until vent stacks and other penetrations through roof have been installed and are securely fastened.
- G. Do not install roof panels until flashing is in place.
- H. Inspect and verify that exterior stucco and EIFS wall enclosures are completed.

3.03 INSTALLATION

- A. Install roof panels in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install roof panels weathertight.
- C. Battens:
 - 1. Install 1 by 4 inch counter-battens vertically over roof rafters/trusses, on 24-inch (610-mm) centers maximum.
 - a. Stagger counter-batten ends.
 - 2. Install 2 by 2 inch battens perpendicular to roof rafters/trusses at 12-5/8 inch (321-mm) centers.
 - a. Stagger batten ends.
 - 3. Fasten counter-battens and battens with fasteners in accordance with manufacturer's instructions.
- D. Valleys: Install in accordance with manufacturer's instructions with a minimum 6-inch (152-mm) overlap in the direction of flow.
- E. Flashing: Install as indicated on the Drawings and in accordance with manufacturer's instructions.
- F. Roof Panels:
 - 1. Install roof panels, accessories, flashing, and hip and ridge level and plumb.
 - 2. Use fasteners as specified and in accordance with the manufacturer's instructions.

3. Install each panel using a random stagger pattern in accordance with the manufacturer's instructions.
4. Fasten each panel with minimum 4 screws minimum horizontally along nosing of each panel; 2 at overlaps, and 2 other intermediate points.
- G. Cut roof panels into each side of valleys in accordance with manufacturer's instructions straight and true to the line of the valley.
- H. Hip and Ridge:
 1. Install hip and ridge along hips, ridges, and rakes as indicated on the Drawings and in accordance with manufacturer's instructions.
- I. Bend and fold exposed ends of hips and ridges and neatly cap with end cap or piece of similar material.
- J. Do not install roof panels in a manner that detracts from the appearance of the roof.
- K. Do not rack panels.
- L. Do not line panels vertically up the roof.
- M. Do not use even panel offsets.
 1. Do not make a pattern with panels.
- N. Do not use the following with roof panel system:
 1. Lead.
 2. Copper.

3.04 ADJUSTING

- A. Repair minor damage to roof panels in accordance with manufacturer's instructions and as approved by Architect.
- B. Remove and replace with new material, damaged components that cannot be successfully repaired, as determined by Architect.

3.05 CLEANING

- A. Clean roof panels of debris, including metal shavings, promptly after installation.

3.06 PROTECTION

- A. Protect Work of this Section to ensure that, except for normal weathering, Work will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 41 13

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes fascia, gutter, downspout, flashing, counterflashing, and similar trim components.
- B. Related Sections:
 - 1. Section 07 6100 - Sheet Metal Roofing
 - 2. Section 07 5216 - Low-Slope Membrane Roofing

1.02 SUBMITTALS

- A. Product Data Sheets - Submit product data sheets on all the following items:
 - 1. Prefinished metal
 - 2. Sealant tape
 - 3. Paint (where used)
 - 4. Paint primer
- B. Shop Drawings - Submit detailed shop drawings as necessary to illustrate the intended configuration of new sheet metal flashing and trim components.
- C. Submit Samples - Prior to mass fabrication, submit to the Architect/Engineer physical samples of each of the following:
 - 1. Color samples for prefinished metal to be selected by Architect for each type of metal indicated on drawings.
- D. Quality Assurance Submittals
 - 1. Submit qualifications for ANSI/SPRI ES-1.
- E. Close-out Submittals
 - 1. Twenty (20) year manufacturer's sheet metal finish warranty.

1.03 QUALITY ASSURANCE

- A. Pre-Construction Roofing Meeting - Reference Section 07 5216. Ensure all installers responsible for sheet metal work are in attendance.
- B. Skilled Workmen - All sheet metal work shall be fabricated and installed by fully trained, qualified sheet metal mechanics properly skilled to perform the Work in accordance with the standards set forth in these Specifications. Substandard Work will be rejected.
- C. Accepted Flashing Details - In the event field conditions make installation of a flashing detail in accordance with SMACNA or NRCA Details impractical, the Contractor shall submit a shop drawing design to the Owner for approval to fit the conditions present.
- D. In-Place Mock-ups:
 - 1. Prepare in-place mock-up of each detail. The approved mock-ups shall become the minimum standards for the Work. Rejected mock-ups shall be removed from the site. Approved mock-ups may remain as part of the Work.
 - 2. Additional mock-ups may be required to properly demonstrate acceptable workmanship.
 - 3. Provide Field Observer 48-hours advanced notification for observation of mock-ups.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage Compliance - Deliver, store, and handle all sheet metal work in accordance with the provisions of other sections.

1.05 PROJECT/SITE CONDITIONS

- A. Dimensions Approximate - Dimensions as contained in these Specifications or as scaled from Detail Drawings shall be presumed to be approximate. In the event that site conditions uncovered during the Work require modification to, or alteration of those specifications, the Contractor shall make adjustments as required to comply with that intent.
- B. Coordination with Other Trades - The Work of this Section shall be coordinated with and properly integrated into related Work covered by other Sections.

PART 2 - PRODUCTS

2.01 METAL FLASHING

- A. Prefinished sheet metal for counterflashings, edge metal flashings, and related components - Kynar-coated galvanized or galvalume metal, 24 gauge unless noted otherwise. To match metal roof color selected by Architect.
- B. Stainless steel sheet for splash pans and similar conditions in continued or prolonged contact with moisture - 24-gauge stainless steel sheet flashing.

2.02 RELATED MATERIALS – SOLDERING

- A. Solder - 50 percent Tin, 50 percent lead - (ASTM D 32), for galvanized sheet metal.
- B. Flux - Rosin, Muriatic acid filled with zinc or non-acid type paste.
- C. Coating - To match existing coating applied over extents of metal roofing.

2.03 RELATED MATERIALS - FASTENERS

- A. Hex-Head Wood Screws - 1-1/2 inches, stainless steel (300 series), with neoprene washers, to fasten square-to-round counter flashings at curbed penetrations, new expansion joint covers, and copings.
- B. Pop Rivets - Pop rivets shall be #44 stainless steel (300 series) with stainless steel shafts. Pop rivets shall be finished using coating to match the color and finish of the sheet metal to which it is attached.
- C. Sheet Metal Screws - All exposed screws used in sheet metal applications shall be stainless steel (300 series).

2.04 RELATED MATERIALS - BITUMINOUS

- A. Asphalt Primer - (ASTM D 41) - for priming metal flanges
- B. Membrane Underlayment - Self-Adhering, High-Temperature Sheet, 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer as recommended by underlayment manufacturer.
 - 1. Thermal Stability - Stable after testing at 240 degrees F; ASTM D 1970.
 - 2. Low-Temperature Flexibility - Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3. Products - Subject to compliance with requirements, provide one of the following:
 - a. Carlisle CCW WIP 300HT.
 - b. Approved equivalent.
 - 4. Flashing Cement - A heavy bodied SBS modified trowel grade asphaltic roof flashing cement to embed flanges of metal flashings; to embed backer plate/cover plate assemblies in gravel guard; and to provide seal as shown in Detail Drawings. Materials shall comply with ASTM D 4586 Asphalt Roof Cement, Asbestos Free, Type I.
 - a. Johns Manville - MBR Utility Cement or approved equivalent.

2.05 RELATED MATERIALS - NON-BITUMINOUS

- A. Sealant - one-component silicone sealant for use at all metal laps and terminations, including copings, gutters, and similar conditions. Dow 795, Tremco Spectrem 1, or approved equivalent.

- B. Sealant Tape - polyisobutylene butyl elastic tape, such as Tremco 440 tape, minimum thickness of 1/8-inch with a 3/4-inch minimum width, unless otherwise instructed for use between metal connections, behind flashing termination bars, lap joints in metal flashings, and at coping seams.
- C. Underlayment Sealant - STPE or similar compatible sealant as recommended by underlayment manufacturer for sealing joints, edges, and similar interfaces of underlayment only.
- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum. As required by roof manufacturer as a separator sheet.

PART 3 - EXECUTION

3.01 GENERAL

- A. Precision Fabrication - Fabricate all flashings to exact, uniform, and consistent dimensions and ensure that same are properly fitted and well seated, particularly backer plates and cover plates.
- B. Minimize Joints - Install all continuous flashings of the longest practical length.
- C. Terminations and Intersections - Where flashings terminate or intersect, utilize and comply with methods and procedures as outlined in the latest edition of the "Architectural Sheet Metal Manual" as distributed by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), the NRCA Roofing and Waterproofing Manual, latest edition, "Copper and Common Sense" manual by Revere Copper, or "The Copper/Brass/Bronze Design Handbook" published by the Copper Development Association, Inc. Construct terminations and intersections as separate, fixed components independent from intersecting, continuous flashings in such a manner as to absorb thermal movement of adjacent components without stress on mitered joints of terminations and intersections. Each corner leg shall be approximately 18-inch long on each leg.
- D. Conflict Resolution and Authority - In the event any metal flashing component of any flashing is not specifically covered by the Specifications, or Drawings, each shall comply with the theory and intent of "NRCA Construction Details" and those of the "Architectural Sheet Metal Manual", Fifth Edition, 1989, as published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
- E. No Dissimilar Metals - In no case, shall dissimilar metals come into contact with each other, nor shall a flashing be constructed in such a way as to permit water from running off one type metal onto another where chemical reaction or corrosion may occur.
- F. Lumber - Sheet metal components, other than nails or screws, shall not come into direct contact with lumber. Wherever lumber is used, a bituminous barrier such as secondary waterproofing membrane, or a #30 asphalt saturated roofing felt shall be used as a permanent separator.
- G. Use of Sealants - Sealants shall be used to provide secondary moisture protection, not primary. Wherever elastomeric sealant is used, it shall be applied beneath the component to be sealed, and both surfaces shall be primed with the primer recommended by the manufacturer. Failure to prime the surfaces of components to be sealed will be considered grounds for removal. Sealant shall match the color of the material to which it is being applied. Non-matching color sealant shall be completely removed, the substrate material cleaned, and new matching sealant applied. Where the sealant cannot be removed or the surface cleaned, the substrate material, or sheet metal shall be removed and replaced with clean material.
- H. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.
 - 1. Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

- a. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, and filled with butyl or silicone sealant concealed within joints. Provide expansion joints at not more than 50 feet on center and not more than 25 feet from corners.

3.02 WOOD BLOCKING AND NAILERS

- A. Materials and installation of wood blocking and nailers are specified elsewhere. Contractor providing Work under this Section shall, however, comply with the following procedures.
- B. Securement - All wood blocking and nailers of any type intended to receive sheet metal attachment are to be securely anchored to the building in accordance with FM Global 1-49 requirements. The Contractor shall notify the Architect/Engineer of any securement deficiency prior to installation of any metal components. Any metal attached to improperly secured wood blocking or nailers shall be removed at the Contractor's expense and reinstalled after the securement has been corrected.
- C. Level and Continuous Nailers - The Contractor is cautioned to ensure that during the installation of all wood blocking a continuously level and smooth elevation is provided to insure a simplicity of installation.
- D. Flange Supports - All metal flanges in imbedded metal details shall bear over wood nailers, not roof insulation, and shall be fully supported by such wood nailers with no gaps.

3.03 SOLDERING

- A. Solder Using Irons - All soldering is to be done using soldering irons heated conventionally in a pot. The use of propane or other types of torches will not be permitted.
- B. Corners and Intersections - Solder only those fixed components such as corners, intersections, terminations, skirts, collars, and covers. Do not solder joints between adjacent 10-foot lengths of flashings.
- C. Cleaning Joints - When forming soldered joints, apply flux to surface and lift overlapping sheet to apply between sheets to minimum 1/2-inch depth. Thoroughly sweat joint drawing solder between sheets to minimum 1/2-inch depth and apply uniform surface without excess build-up.
- D. No Exposed Nails - Do not nail metal components in place and solder over nail heads. If necessary to join components prior to soldering, use only stainless steel pop rivets. Cut, notch, miter, and provide tabs as necessary to properly join and interlock individual components for soldering.
- E. Surface Treatment - Immediately neutralize all flux from surfaces after soldering, using cloth saturated with 10 percent solution of washing soda and water, and wipe again using separate cloth and water. Upon completion of pop riveting and soldering spray soldered joint and pop rivet heads with "Instant Cold Galvanizing Compound" to prevent rusting.

3.04 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate as recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply 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. Roll laps and edges with roller. Cover underlayment within 14 days.
 1. Apply self-adhering sheet underlayment over entire roof area to be covered with sheet metal and integrate with adjacent components as indicated on the drawings.
 2. Detail interfaces by integrating with roof edges and terminations in a watertight manner.
- B. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal roofing and related flashing.

3.05 WATER CONVEYANCE SHEET METAL

- A. Gutters - All gutters shall be constructed of terne-coated stainless steel sheet metal, with fully soldered and sealed joints. Match existing profile and attachment.
 - 1. Line gutter framing continuously with membrane underlayment to provide a watertight assembly prior to installation of metal gutters, as shown on drawings.
 - 2. Overlap joints in gutters minimum 3 inches and fully embed in silicone sealant. Orient laps in direction of water flow.
 - 3. Provide expansion joints in gutter with locked and sealed seams as described above.
 - 4. Water test entire length of gutters and downspout connections to verify watertightness. Notify Architect and Engineer at least 72 hours prior to testing and provide written report of results to Owner.
- B. Downspouts – General intent is to reuse existing downspouts. If replaced, downspouts to match existing. Connect to existing subgrade downspout piping.
 - 1. Anchors for downspouts: circular galvalume pipe bracket to fit around downspout, with 3/8-inch stainless steel anchors for mounting to exterior masonry. Install only into mortar joints in backup wall or, where new stucco is present, into stucco finish.

3.06 WATER SHEDDING SHEET METAL

- A. Counterflashings
 - 1. Walls and Elevation Changes - Fabricate counterflashings, using sheet metal of the approximate dimensions and configurations shown on the Detail Drawings, or as necessary to overlap base flashings a minimum of 4 inches. Materials shall be compatible and shall match the material already present on the building in similar details.
 - 2. Equipment cannot be its own counterflashing - Equipment flanges cannot be a substitute for separate two-piece counterflashing. All equipment must have a separate receiver and counterflashing beneath the equipment flange.
 - 3. Equipment Curbs - Fabricate counterflashing of 24 ga. flashing to match surrounding roofing, and of prefinished metal at low-slope roofs, as detailed with reverse open hem (approximately 1 inch) on the vertical face extending over top of curb. Fasten 16 inches on-center with approved fasteners with a minimum of two fasteners per side. All vent and plumbing and HVAC flashings shall have soldered and pop riveted seams. Seams and joints are not to be sealed with sealant as primary waterproofing.
 - 4. Expansion Provisions - Fabricate all counterflashings in such a manner that each may be removed and reinstalled if necessary. Provide for differential movement between base flashing and counterflashing assemblies at all locations.
 - 5. Wind Clips - All counterflashings at walls shall have 2-inch wide wind clips at 24 inches on-center in accordance with SMACNA provisions.
- B. Splash Pans/Downspout Covers
 - 1. Provide pre-manufactured stainless splash pans below downspouts over low roofs.
 - 2. Provide precast concrete splash blocks below downspouts that outlet at grade.
 - 3. Provide metal sidewalk covers for downspouts that route below sidewalks and finished paving.
 - 4. Provide cast-iron downspout covers where downspouts are exposed to vehicular traffic.

END OF SECTION 076200

**SECTION 07 92 00
JOINT SEALANTS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3.
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints in unit masonry.
 - b. Joints in dimension stone cladding.
 - c. Joints in glass unit masonry assemblies.
 - d. Joints in exterior portland cement stucco
 - e. Joints between metal panels.
 - 2. Joints between different materials listed above.
 - a. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - b. Control joints in ceilings and other overhead surfaces.
 - c. Other joints as indicated.
 - 3. Exterior joints in the following horizontal traffic surfaces:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - c. Other joints as indicated.
 - 4. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - f. Other joints as indicated.
 - 5. Interior joints in the following horizontal traffic surfaces:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control joints in tile flooring.
 - c. Other joints as indicated.
- B. Related Sections include the following:
 - 1. DIVISION 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 2. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
 - 3. Division 08 Section "Glazing" for glazing sealants.
 - 4. Division 09 Section "Portland Cement Stucco" for sealing perimeter joints of gypsum veneer plaster partitions to reduce sound transmission.
 - 5. Division 09 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
 - 6. Division 09 Section "Tiling" for sealing tile joints.
 - 7. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.03 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.

1.04 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.05 SAMPLES FOR VERIFICATION: FOR EACH TYPE AND COLOR OF JOINT SEALANT REQUIRED, PROVIDE SAMPLES WITH JOINT SEALANTS IN 1/2-INCH- (13-MM-) WIDE JOINTS FORMED BETWEEN TWO 6-INCH- (150-MM-) LONG STRIPS OF MATERIAL MATCHING THE APPEARANCE OF EXPOSED SURFACES ADJACENT TO JOINT SEALANTS.

- A. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- B. Qualification Data: For Installer.
- C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.
- E. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 - 1. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- F. 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.

1.07 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

- B. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.08 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.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 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. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.

2.03 COLORS OF EXPOSED JOINT SEALANTS: AS SELECTED BY ARCHITECT FROM MANUFACTURER'S FULL RANGE.

2.04 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: Where elastomeric sealants are specified to 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.

2.05 SUITABILITY FOR IMMERSION IN LIQUIDS. WHERE ELASTOMERIC SEALANTS ARE INDICATED FOR USE I FOR JOINTS THAT WILL BE CONTINUOUSLY IMMERSSED IN LIQUIDS, PROVIDE PRODUCTS THAT HAVE UNDERGONE TESTING ACCORDING TO ASTM C 1247 AND QUALIFY FOR THE LENGTH OF EXPOSURE INDICATED BY REFERENCE TO ASTM C 920 FOR CLASS 1 OR 2. LIQUID USED FOR TESTING SEALANTS IS DEIONIZED WATER, UNLESS OTHERWISE INDICATED.

- A. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600
- B. Single-Component Non-sag Polyether Sealant ES-A (Very Low VOC [less than 2%]):
 - 1. Available Products Very Low VOC (less than 2%)
 - a. STS Coatings, GreatSeal PE-.150 (830-995-5177)
 - b. Sonneborn, Division of BASF: Sonolastic 150.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: galvanized steel, brick, and concrete.
 - 6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
 - 7. Exterior Gypsum Joint Sealants (Very Low VOC less than 2%) (IECC Required)
 - a. LT-100 Sealant by STS Coatings (830-995-5177)
 - 8. UniverSeal by York Mfg. (800-551-2828)
- C. Single-Component Neutral-Curing Silicone Sealant ES- B:
 - 1. Available Products:
 - a. Sonneborn, Division of ChemRex Inc., BASF; Omniseal 50.
 - b. Dow Corning Corporation; 795
 - c. GE Silicones; SilPruf NB SCS9000.
 - d. Pecora Corporation; 895.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 50.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Glass and color anodic aluminum.
- D. Single-Component Acid-Curing Silicone Sealant ES-C:
 - 1. Available Products:
 - a. Dow Corning Corporation; 999-A.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Pecora Corporation; 860..
 - d. Sonneborn, Division of ChemRex Inc.; OmniPlus.
 - e. Tremco; Tremsil 200.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: ceramic tile and stainless steel.
- E. Multicomponent Nonsag Urethane Sealant ES-D:
 - 1. Available Products:
 - a. Sonneborn, Division of ChemRex Inc.; NP 2.

2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 25.
 4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, galvanized steel, brick, and ceramic tile.
- F. Multicomponent Pourable Urethane Sealant ES-E:
1. Available Products:
 - a. Pecora Corporation; Dynatrol II-SG.
 - b. Sika Corporation, Inc.; Sikaflex - 2c SL.
 - c. Sonneborn, Division of ChemRex Inc.; SL 2.
 2. Type and Grade: M (multicomponent) and P (pourable).
 3. Class: 25.
 4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: ceramic tile and concrete.

2.06 ACOUSTICAL JOINT SEALANTS

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

2.07 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), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, 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 (minus 32 deg C). 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.

2.08 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

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, 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. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. 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. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.

3.03 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.

- A. 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.

3.04 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- C. 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.
- D. 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.
- E. install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- F. 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.
- G. 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.
 - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.
- I. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
- J. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 - 1. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
 - 2. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 - 3. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- K. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.05 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab or Method D, Water Immersion in Appendix X1 in ASTM C 1193, as appropriate for type of joint-sealant application indicated.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
 4. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free of voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
 5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.06 CLEANING

- A. 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.

3.07 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.08 JOINT-SEALANT SCHEDULE.

LOCATION	TYPE	COLOR
WINDOW PERIMETER, FRAMES, STOREFRONT OR CURTAIN WALL ASSEMBLY	B	TO MATCH ADJACENT

DOOR FRAMES/WALL PERIMETERS	A	TO MATCH ADJACENT
UNDER THRESHOLDS.		
UNDER WINDOW SYSTEM WHICH RESTS DIRECTLY ON THE FLOOR SLAB IN ORDER TO PREVENT INFILTRATION	A	BLACK
TOILET ROOM FIXTURES, ACCESSORIES; CERAMIC TILE	C	WHITE
INTERSECTION OF DISSIMILAR MATERIALS THAT ALLOWS WATER OR AIR INFILTRATION	A	TO MATCH ADJACENT
PERIMETER JOINTS ON INTERIOR SIDE OF DOOR FRAMES, LOUVERS IN EXTERIOR WALLS	A	TO MATCH ADJACENT
PERIMETER JOINTS OF DOOR FRAMES, WINDOW FRAMES AND OTHER FRAMED OPENINGS IN WALLS WITH NO FINISHED EDGE FLANGE.	A	TO MATCH ADJACENT
OPEN JOINTS AT PENETRATIONS THROUGH WALLS, AND OPEN JOINTS AT PENETRATIONS THROUGH CONCRETE OR GYPSUM BOARD CEILINGS, WHERE INTENDED TO BE TIGHT SEALED JOINTS.	A	TO MATCH ADJACENT
OPEN JOINT, BETWEEN DISSIMILAR MATERIALS WHERE INTENDED TO BE TIGHT, SEALED JOINT.	A	TO MATCH ADJACENT
JOINTS WHERE EDGE TRIM OF GYPSUM BOARD ABUTS IRREGULAR SU		

END OF SECTION 07 92 00

This page intentionally left blank

**SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Expansion joint cover assemblies for floor, wall, ceiling, and soffit surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board control joint trim.
- C. Section 09 51 00 - Acoustical Ceilings: Expansion joint assemblies in suspended ceiling grids.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
 - 1. Balco, Inc; _____: www.balcousa.com/#sle.
 - 2. Construction Specialties, Inc; _____: www.c-sgroup.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Floor Joints Subject to Thermal Movement:
 - 1. Manufacturers:
 - a. Balco, Inc; No-Bump Floor to Floor System, Aluminum (NBAF): www.balcousa.com/#sle.
 - b. Construction Specialties, Inc; Allway Standard Metal Floor Covers: www.c-sgroup.com/#sle.
 - c. Watson Bowman Acme Corporation; Wabo CorridorWrap Floor: www.watsonbowmanacme.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement:
 - 1. Manufacturers:
 - a. Balco, Inc; WD Wall and Ceiling Snap-On Joint Cover: www.balcousa.com/#sle.
 - b. Construction Specialties, Inc; Allway Standard Wall and Ceiling Covers: www.c-sgroup.com/#sle.

- c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Interior Fire-Rated Wall/Ceiling/Floor Joints Subject to Thermal Movement:
 - 1. Manufacturers:
 - a. Construction Specialties, Inc; Fire Barriers: www.c-sgroup.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Interior/Exterior Fire-Rated Wall Joints Subject to Thermal Movement:
 - 1. Manufacturers:
 - a. EMSEAL Joint Systems, Ltd; Emshield WFR2 System: www.emseal.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 - 4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
 - 1. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.
- D. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- E. Covers in Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
 - 1. Exposed Finish at Floors: Mill finish or natural anodized.
 - 2. Exposed Finish at Walls and Ceilings: Natural anodized.
- B. Resilient Seals:
 - 1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
 - 2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
- C. Anchors and Fasteners: As recommended by cover manufacturer.
- D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- E. Threaded Fasteners: Aluminum.
- F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION 07 95 13

This page intentionally left blank

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- I. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: <https://steeldoors.org/sdi-certified/#sle>.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company; "Imperial" door: www.assaabloydss.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Door Edge Profile: Manufacturers standard for application indicated.
 - 4. Typical Door Face Sheets: Flush.
 - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
 - 6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - 7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the

requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - 2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 - 3. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Face welded type.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 - 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - 3. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire Rated: Face welded type.
 - 1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
 - 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
- E. Door Frames, Fire-Rated: Face welded type.
 - 1. Fire Rating: Same as door, labeled.
 - 2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
 - 3. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 71 00.
- E. Comply with glazing installation requirements of Section 08 80 00.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 11 13

**SECTION 08 12 13
HOLLOW METAL FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.
- B. Fire-rated hollow metal frames for non-hollow metal doors.
- C. Interior glazed borrowed lite frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- B. Section 08 71 00 - Door Hardware: Hardware, silencers, and weatherstripping.
- C. Section 08 80 00 - Glazing: Glazed borrowed lites.

1.03 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- M. ITS (DIR) - Directory of Listed Products; Current Edition.
- N. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- O. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- P. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- R. UL (DIR) - Online Certifications Directory; Current Edition.
- S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal frames from SDI Certified manufacturer: <https://steeldoors.org/sdi-certified/#sle>.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Frames with Integral Casings:
 - 1. Ceco Door, an Assa Abloy Group company; ____: www.assaabloydss.com/#sle.
 - 2. Deansteel Manufacturing Company, Inc; Hurricane TDI Door & Frame: www.deansteel.com/#sle.
 - 3. Republic Doors, an Allegion brand; ____: www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Hollow Metal Frames: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific frame type:
 - 1. Performance Class (PC): AW.
 - 2. Performance Grade (PG): 40, with minimum design pressure (DP) of 40.0 psf.
- B. Refer to Door and Frame Schedule on drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- C. Door Frame Type: Provide hollow metal door frames with integral casings.
 - 1. Interior Doors: Use frames with integral casings.
- D. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- E. Accessibility: Comply with ICC A117.1 and ADA Standards.

- F. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
- G. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- H. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- I. Zinc Coating for Units Subject to Corrosive Conditions: Components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise.
- J. Mullions for Pairs of Doors: Fixed, with profile similar to jambs.
- K. Transom Bars: Fixed, of profile same as jamb and head.
- L. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.
- M. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- N. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into head of frame, and flush with top.

2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

- A. Frame Finish: Factory primed and field finished.
- B. Exterior Door Frames: Knock-down type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
 - 2. Weatherstripping: See Section 08 71 00.
- C. Interior Door Frames, Non-Fire Rated: Face welded type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
 - 2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inches above floor at 45 degree angle.
- D. Type ____, Fire-Rated Door Frames: Knock-down type.
 - 1. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C or NFPA 252 ("positive pressure fire tests").
 - 2. Provide units listed and labeled by ITS (DIR) or UL (DIR).
 - a. Attach fire rating label to each fire rated unit.

2.04 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

- B. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Comply with glazing installation requirements of Section 08 80 00.
- F. Install door hardware as specified in Section 08 71 00.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.05 SCHEDULE - SEE DRAWINGS

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 12 13

**SECTION 08 14 16
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 12 13 - Hollow Metal Frames.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- D. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 2. Include certification program label.
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- E. Manufacturer's Installation Instructions: Indicate special installation instructions.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Specimen warranty.
- I. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Woodwork Quality Assurance Program:
 - 1. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by quality assurance program.
 - 3. Provide designated labels on installed products as required by quality assurance program.
 - 4. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
 - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. High Pressure Decorative Laminate (HPDL) Faced Doors:
 - 1. VT Industries, Inc; Heritage Collection: www.vtindustries.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. High pressure decorative laminate (HPDL) finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

- A. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; match existing; textured, low gloss finish.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION 08 14 16

This page intentionally left blank

SECTION 08 41 13.22
ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section covers Kawneer Aluminum Entrances, including glass and glazing, door hardware, and components.
- B. Types of Kawneer Aluminum Entrances include:
 - 1. 350 Heavy Wall™ Swing Door:
 - a. Medium stile
 - b. Vertical face dimension: 3-1/2" (88.9 mm)
 - c. Depth: 2" (50.8 mm)
 - d. Wall thickness: 3/16" (4.8 mm) for high traffic applications
- C. Related Sections:
 - 1. 072700: Air Barriers
 - 2. 079200: Joint Sealants
 - 3. 083213: Sliding Aluminum-Framed Glass Doors
 - 4. 084313: Aluminum-Framed Storefronts
 - 5. 084329: Sliding Storefronts
 - 6. 084413: Glazed Aluminum Curtain Walls
 - 7. 084433: Sloped Glazing Assemblies
 - 8. 085113: Aluminum Windows
 - 9. 086300: Metal-Framed Skylights
 - 10. 087000: Hardware
 - 11. 088000: Glazing
 - 12. 280000: Electronic Safety and Security

1.03 DEFINITIONS

- A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance:
 - 1. Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Wind Loads:
 - 1. The entrance system shall include anchorage that is capable of withstanding the following wind load design pressures:
 - a. Inward: 20 psf
 - b. Outward: 20 psf
 - 2. The design pressures are based on the IBC Building Code, 2018 Edition.
- C. Air Leakage:
 - 1. For single-acting offset pivot or butt-hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E 283 at a pressure differential of 1.57 psf (75 Pa) for single doors and pairs of doors.

2. A single 3'0" x 7'0" (915 mm x 2134 mm) entrance door and frame shall not exceed 1.0 cfm/ft².
 3. A pair of 6'0" x 7'0" (1830 mm x 2134 mm) entrance doors and frame shall not exceed 1.0 cfm/ft².
- D. Uniform Load:
1. A static air design load of 85 psf (4070 Pa), or 65 psf (3113 Pa) for laminated infill, shall be applied in the positive and negative direction in accordance with Florida Building Code TAS-202 and ASTM E 330.
 2. There shall be no deflection in excess of L/180 of the span of any framing member at design load.
 3. At a structural test load equal to 1.5 times the specified design load, no glass breakage shall occur.
- E. Structural-Test Performance:
1. Corner strength shall be tested per the Kawneer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity. (Testing procedure and certified test results are available upon request.)
- F. Windborne-Debris-Impact Resistance Performance:
1. Performance shall be tested in accordance with ASTM E1886 and information in ASTM E1996, and in TAS-201/203:
 - a. Large-Missile Impact: For aluminum-framed systems located within 30 feet (9.1 m) of grade
 - b. Small-Missile Impact: For aluminum-framed systems located above 30 feet (9.1 m) of grade

1.05 SUBMITTALS

- A. Product Data:
1. For each type of aluminum-framed entrance door indicated, include:
 - a. Construction details
 - b. Material descriptions
 - c. Fabrication methods
 - d. Dimensions of individual components and profiles
 - e. Hardware
 - f. Finishes
 - g. Installation instructions
- B. Shop Drawings:
1. Plans
 2. Elevations
 3. Sections
 4. Details
 5. Hardware
 6. Attachments to other work
 7. Operational clearances
 8. Installation details
- C. Samples for Initial Selection:
1. Provide samples for units with factory-applied color finishes.
 2. Provide samples of hardware and accessories involving color selection.
- D. Product Test Reports:
1. Provide test reports for each type of aluminum-framed entrance door used in the project.

2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
3. Test reports must indicate compliance with performance requirements.
- E. Entrance Door Hardware Schedule:
 1. Schedule shall be prepared by or under the supervision of supplier.
 2. Schedule shall detail fabrication and assembly of entrance door hardware, including procedures and diagrams.
 3. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer must have successfully installed the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications:
 1. Manufacturer must be capable of fabricating aluminum-framed entrance doors and storefronts that meet or exceed the stated performance requirements.
 2. Manufacturer must document this performance by the inclusion of test reports and calculations.
- C. Source Limitations:
 1. Obtain aluminum-framed entrance doors through one source from a single manufacturer.
- D. Product Options:
 1. Drawings indicate size, profiles, and dimensional requirements of aluminum-framed entrance doors and are based on the specific system indicated. Refer to Division 01 Product Requirements Section. Do not modify size and dimensional requirements.
 2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Pre-installation Conference:
 1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.07 PROJECT CONDITIONS

- A. Field Measurements:
 1. Indicate measurements on shop drawings.

1.08 WARRANTY

- A. Submit manufacturer's standard warranty for owner's acceptance.
- B. Warranty Period:
 1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product:
 1. Kawneer Company, Inc.
 2. The door stile and rail face dimensions of the entrance door will be as follows:
 - a. 350 Heavy Wall™ Swing Door:
 - 1) Vertical face dimension: 3-1/2" (88.9 mm)

- 2) Top Rail: 3-1/2" (88.9 mm)
 - 3) Bottom Rail: 6-1/2" (165.1 mm)
 - 4) Optional Bottom Rail: 10" (254.0 mm)
 3. Major portions of the door members shall be 0.188" (4.8 mm) nominal thickness.
 4. Glazing molding shall be 0.05" (1.3 mm) thick.
 5. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
 6. (350/500 Heavywall™) Provide adjustable glass jacks to help center the glass in the door opening.
- B. Substitutions:
1. Refer to Division 01 Substitutions Section for procedures and submission requirements.
 2. Pre-Contract (Bidding Period) Substitutions:
 - a. Submit written requests ten (10) days prior to bid date.
 3. Post-Contract (Construction Period) Substitutions:
 - a. Submit written request in order to avoid installation and construction delays.
 4. Product Literature and Drawings:
 - a. Submit product literature and drawings modified to suit specific project requirements and job conditions.
 5. Certificates:
 - a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to adherence to specification requirements for aluminum-framed entrance door system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum-framed entrance doors for a period of not less than ten (10) years. (Company Name)
 6. Test Reports:
 - a. Submit test reports verifying compliance with each test requirement required by the project.
 7. Samples:
 - a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
- C. Substitution Acceptance:
1. Acceptance will be in written form, either as an addendum or modification.
 2. Acceptance will be documented by a formal change order signed by the owner and contractor.

2.02 MATERIALS

- A. Aluminum Extrusions:
1. Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish.
 2. Not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.
- B. Fasteners:
1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories:
1. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
 2. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.
- D. Reinforcing Members:

1. Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
 2. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.
- E. Weather Seals:
1. Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material.
 2. Comply with AAMA 701/702.
- F. Red List Free:
1. All parts and materials comply with the Living Building Challenge/DECLARE Red List and the Cradle-to-Cradle (C2C) Banned List:
 - a. PVC-free
 - b. Neoprene-free
 2. Product does not contain PVC or Neoprene.

2.03 STOREFRONT ENTRANCE FRAMING SYSTEM

- A. Storefront Entrance Framing:
1. Trifab® VersaGlaze® 450/451/451T
- B. Non-Brackets and Reinforcements:
1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.
- C. Fasteners and Accessories:
1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
 2. Where exposed, fasteners and accessories shall be stainless steel.
- D. Perimeter Anchors:
1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- E. Packing, Shipping, Handling, and Unloading:
1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. Storage and Protection:
1. Store materials so that they are protected from exposure to harmful weather conditions.
 2. Handle material and components to avoid damage.
 3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.04 GLAZING

- A. Glazing shall comply with requirements in Division 08 Glazing Section.
- B. Glazing Gaskets:
1. Manufacturer's standard compression types
 2. Replaceable, extruded EPDM rubber
- C. Spacers and Setting Blocks:
1. Manufacturer's standard elastomeric type

2.05 HARDWARE

- A. General Hardware Requirements:

1. Provide manufacturer's standard hardware.
2. Hardware shall be fabricated from aluminum, stainless steel, or other corrosion-resistant material that is compatible with aluminum.
3. Hardware shall be designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.
- B. Standard Hardware (350/500 Heavy Wall™):
 1. Weather-Stripping:
 - a. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal using wool pile with polymeric fin.
 - b. The door weathering on a single-acting offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
 2. Sill Sweep Strips:
 - a. EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (necessary to meet specified performance tests)
 3. Threshold:
 - a. Extruded aluminum
 - b. One piece per door opening
 - c. Ribbed surface
 4. Offset Pivots: (Manufacturer's standard for this application)
 5. Butt Hinge: (Manufacturer's standard for this application)
 6. Continuous Hinge: (Manufacturer's standard for this application)
 7. Push/Pull: (Manufacturer's standard for this application)
 8. Exit Device: (Manufacturer's standard for this application)
 9. Closer: (Manufacturer's standard for this application)
 10. Security Lock/Dead Lock:
 - a. Active Leaf: (Manufacturer's standard for this application)
 - b. Inactive Leaf: (Manufacturer's standard for this application)
 11. Latch Handle: (Manufacturer's standard for this application)
 12. Cylinder(s)/Thumbturn: (Manufacturer's standard for this application)
 13. Electric Strike/Strike Keeper: (Manufacturer's standard for this application)

2.06 FABRICATION

- A. Fabricate aluminum-framed entrance doors in sizes indicated.
- B. Include a complete system for assembling components and anchoring doors.
- C. Fabrication requirements:
 1. Aluminum-framed glass doors shall be reglazable without dismantling perimeter framing.
 2. Door corner construction:
 - a. Mechanical clip fastening
 - b. SIGMA deep-penetration plug welds
 - c. 1-1/8" (28.6 mm) long fillet welds inside and outside of all four corners
 - d. Hook-in type glazing stops with EPDM glazing gaskets reinforced with non-stretchable cord
 3. Joint construction:
 - a. Accurately fit and secure joints and corners.
 - b. Make joints hairline in appearance.
 4. Prepare components with internal reinforcement for door hardware.
 5. Arrange fasteners and attachments to conceal from view.
- D. Weather-stripping:

1. Provide weather-stripping locked into extruded grooves in door panels or frames as indicated on manufacturer's drawings and details.

2.07 ALUMINUM FINISHES

- A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
 1. Kawneer Permanodic® AA-M10C21A41, AAMA 611, Architectural Class I Clear Anodic Coating (Color #14 Clear)

PART 3 EXECUTION

3.01 EXAMINATION

- A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:
 1. Verify rough opening dimensions.
 2. Verify levelness of sill plate.
 3. Verify operational clearances.
 4. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components for proper water management.
 5. Masonry Surfaces:
 - a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.
 6. Wood Frame Walls:
 - a. Wood frame walls must be dry, clean, sound, well nailed, free of voids, and without offsets at joints.
 - b. Ensure that nail heads are driven flush with surfaces in opening and within 3" (76.2 mm) of opening.
 7. Metal Surfaces:
 - a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).
 - b. Ensure that metal surfaces are without sharp edges or offsets at joints.
- B. Proceed with installation only after correcting unsatisfactory conditions.

3.02 INSTALLATION

- A. Comply with drawings, shop drawings, and manufacturer's written instructions for installing aluminum-framed entrance doors, hardware, accessories, and other components.
- B. Install aluminum-framed entrance doors so that the doors:
 1. Are level, plumb, square, and true to line
 2. Are without distortion and do not impede thermal movement
 3. Are anchored securely in place to structural support
 4. Are in proper relation to wall flashing and other adjacent construction
- C. Set the sill threshold in a bed of sealant, as indicated, for weathertight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 1. Upon owner's written request, provide periodic site visit by manufacturer's field service representative.

3.04 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjusting: Not applicable.
- B. Protection:
 - 1. Protect installed product's finish surfaces from damage during construction.
- C. Cleaning:
 - 1. Avoid damaging protective coatings and finishes.
 - 2. Clean glass and aluminum surfaces of product immediately after installation.
 - 3. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.
 - 4. Remove non-permanent labels and clean surfaces.
 - 5. Remove excess sealants, glazing materials, dirt, and other substances.
 - 6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
 - 7. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08 41 13.22

**SECTION 08 51 13
ALUMINUM WINDOWS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2021.
- B. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

1.02 SUMMARY

- A. Section Includes:
 - 1. Fixed Aluminum Window Units
 - 2. Glass and Glazing for Aluminum Windows.
 - 3. Wood Blocking, Shims, Anchors, Clips, and all accessories necessary for a complete installation furnished and installed.
 - 4. All aluminum trim and closure pieces
 - 5. 5. Installation labor, tools, equipment, and services necessary for installation of Aluminum Windows.
- B. Related Sections:
 - 1. Section 07 62 00 (07620) - Sheet Metal Flashing and Trim
 - 2. Section 07 92 00 (07920) - Joint Sealants
 - 3. Section 08 13 73 (08130) – Sliding Aluminum Doors and Frames
 - 4. Section 08 41 13 (08410) – Aluminum Entrances and Storefront
 - 5. Section 08 80 00 (08800) - Glazing

1.03 REFERENCES

- A. Aluminum Association (AA)
 - 1. DAF-45 – “Designation System for Aluminum Finishes”
- B. Fenestration and Glazing Industry Alliance (FGIA) (a.k.a.) American Architectural Manufacturers Association (AAMA):
 - 1. 101 – “Voluntary Performance Specification for Windows, Skylights and Glass Doors”
 - 2. 502 – “Voluntary Specification for Field Testing of Newly Installed Fenestration Products”
 - 3. 513 – “Voluntary Specification for Standard Laboratory Test Method For Determination Of Forces And Motions Required To Activate Operable Parts Of Operable Windows And Doors In Accessible Spaces”
 - 4. 611 – “Voluntary Specification for Anodized Architectural Aluminum”
 - 5. 1503 – “Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections”
 - 6. 2400 – “Voluntary Specification for Installation of Windows with a Mounting Flange in Stud Frame Construction”
 - 7. 2604 – “Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels”
 - 8. 2605 – “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Aluminum Extrusions and Panels”
 - 9. CW-10 – “Care and Handling of Architectural Aluminum from Shop to Site”
- C. American National Standards Institute (ANSI) Publications
 - 1. Z97.1 – “Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings”

- D. DASTM International (ASTM) Publications:
 - 1. C518 – “Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus”
 - 2. C1036 – “Standard Specifications for Flat Glass”
 - 3. C1048 – “Standard Specifications for Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass”
 - 4. D3985 – “Standard Test Method for Oxygen Gas Transmission Rate Through Plastic Film and Sheet Using a Coulometric Sensor”
 - 5. E90 – “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements”
 - 6. E283 – “Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen”
 - 7. E330 – “Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference”
 - 8. E331 – “Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference”
 - 9. E413 – “Classification for Rating Sound Insulation”
 - 10. E547 – “Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential”
 - 11. E774 – “Standard Specification for Sealed Insulating Glass Units”
 - 12. F588 - “Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact”
 - 13. F1249 – “Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheet Using a Modulated Infrared Sensor”
- E. National Glass Association (NGA):
 - 1. “GANA Glazing Manual”
- F. Insulating Glass Certification Council (IGCC)
- G. National Fenestration Ratings Council (NFRC)
- H. U.S. Consumer Product Safety Commission (CPSC) Publications:
 - 1. 16 CFR Part 1201 “Safety Standard For Architectural Glazing Materials”
- I. Window and Door Manufacturers Association (WDMA) Publications:
 - 1. FGIA/AAMA/WDMA 101/I.S.2/NAFS “Voluntary Performance Specification for Windows, Skylights and Glass Doors”
 - 2. FGIA/AAMA/WDMA/CSA 101/I.S.2/A440 “Standard/Specification for Windows, Doors and Unit Skylights”

1.04 SUBMITTALS

- A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) – with the following supporting data:
 - 1. Product data for each type of aluminum window specified, including standard construction details, dimensions of individual components, profiles, finishes, and accessories.
 - 2. Shop drawings for each type of window specified, including 1/4-inch scale wall elevations, typical unit elevations at 3/4-inch scale details, full size details of typical composite members and the following:
 - a. Panning Details
 - b. Flashing and drainage details.
 - c. Mullion details, including reinforcement and stiffeners.
 - d. Joinery details.
 - 3. glazing system, quality of construction and finish.
 - 4. window units comply with specified performance requirements.

5. Submit certified independent laboratory test reports verifying compliance with all test requirements of 1.05 PERFORMANCE REQUIREMENTS as requested by Architect.

1.05 DEFINITIONS

- A. Performance grade number, included as part of the FGIA/AAMA/WDMA/CSA 101/I.S.2/A440 product designation code, is actual design pressure in pounds force per square foot used to determine structural test pressure and water test pressure.

1.06 PERFORMANCE REQUIREMENTS

- A. Architectural Manufacturers Association (FGIA/AAMA/WDMA) Specification for Performance Class specified complying with the following performance standards:
 1. FGIA/AAMA/WDMA/CSA 101/I.S.2/A440 Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with FGIA/AAMA/WDMA/CSA 101/I.S.2/A440.
 - a. Performance Class: F-AW
 - b. Performance Grade: 110
 2. Uniform Structural Properties (ASTM E330): Pressure acting inward and outward. No permanent damage to glass or fasteners shall occur with permanent deformation at a maximum of 1/175 of its span, when tested at a static air pressure difference of the following:
 - a. Class F-AW-110: 165.0 PSF
 3. Water Resistance (ASTM E331 and ASTM E547): No water penetration at test pressure indicated.
 - a. Class F-AW-110: 12.0 PSF
 4. Air Leakage (ASTM E283):
 - a. Maximum 0.3 CFM per sq./ft. of total exterior surface area, when tested at a static air pressure differential of 6.2 PSF minimum.
- B. Project Wind Loads:
 1. The system shall be designed to withstand the following loads with respect to the plane of the wall:
 - a. Positive pressure of 20 p.s.f. at non corner zones.
 - b. Negative pressure of 20 p.s.f. at non corner zones.
 - c. Negative pressure of 20 p.s.f. at corner zones.

1.07 QUALITY ASSURANCE

- A. All window units shall be manufactured by a single source.
 1. All windows in any one project must be by the same manufacturer and with comparable frame depth, profile, glazing bite, and installation requirements. Manufacturer must provide a window system that can incorporate all window configurations used on the project.
- B. Standards: Requirements for aluminum windows, terminology and standard of performance, and fabrication workmanship are those specified and recommended in FGIA/AAMA/WDMA/CSA 101/I.S.2/A440 and The Aluminum Association (AA).
 - a. All window units shall be labeled as conforming to FGIA/AAMA/WDMA/CSA 101/I.S.2/A440. The label shall state the name of the manufacturer, the approved labeling agency and the product designation as specified in FGIA/AAMA/WDMA/CSA 101/I.S.2/A440.
 - b. All testing shall be conducted using FGIA/AAMA/WDMA/CSA 101/I.S.2/A440 Gateway Performance minimum specified test sizes.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Transportation and Handling: Transport products by methods to avoid product damage, deliver in undamaged condition in manufacturer's unopened containers or packaging. Provide

equipment and personnel to handle products by method to prevent soiling or damage. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

- B. Storage and Protection: Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain with temperature and humidity ranges required by manufacturer's instruction.

1.09 WARRANTIES

- A. Aluminum Window Warranty
 - 1. Products: Submit a written warranty, executed by the window manufacturer, for the following:
 - a. Framing components: A period of (5) years from the date of manufacture, against defective materials and workmanship, including substantial non-compliance with applicable specification requirements and industry standards, which results in premature failure of the windows or parts, outside of normal wear.
 - b. Insulating glass units: A period of (10) years from the date of manufacture, against insulating glass seal failure unrelated to glass breakage.
 - c. In the event windows or components are found defective, manufacturer will repair or provide replacements without charge at manufacturer's option.
 - d. Where applicable, materials which are applied to the face of insulating glass for the purpose of simulating division in glass openings (SDL's) are warranted against detaching from the glass surface for a period of (5) years.
 - e. Finish: Refer to Part 2, Section 2.06 "FINISHES" for warranty requirements.
 - f. Warranty for all components must be direct from the manufacturer (non-pass through) and non-prorated for the entire term. Warranty must be assignable to the non-residential owner, and transferable to subsequent owners through its length.
 - 2. Installation: Submit a written warranty, executed by the window installer, for a period of (1) year from the date of substantial completion, against defective materials or workmanship, including substantial non-compliance with applicable specification requirements, which result in premature failure.
 - a. In the event installation of windows or components is found to be defective, installer will repair or provide replacements without charge at the installer's option.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
- B. Quaker Window Products Company, Inc. (800) 347-0438
 - 1. Fixed Window: "H450 DS Series"
 - 2. Substitutions: Only pre-approved products specified by the Architect will be acceptable. Submit the following information with proper documentation as required for pre-bid substitution requests, and at least (10) working days prior to bid date.
 - a. Independent test reports certifying that proposed product is in accordance with, and meets all criteria specified in Section 1.05 "PERFORMANCE REQUIREMENTS".
 - b. Drawing details of elevations and sections, and samples in accordance with, and as specified in Section 1.03 "SUBMITTALS".
 - c. Copy of manufacturer's warranty specified in accordance with, and as specified in Section 1.08 "WARRANTIES".
 - d. Any additional information requested by the Architect.

2.02 MATERIALS

- A. Aluminum Members:
 - 1. Extruded aluminum prime billet 6063-T6 alloy for primary components, 6063-T6, or 6061-T6 for structural components, all in accordance with ((ASTM B221))).

B. Structural Thermal Break Construction:

1. Frame and sash members shall include a structural thermal barrier, applied in the manufacturer's facility, using concealed low-conductance poured-in-place polyurethane in a pre-treated cavity.
2. After proper curing, the aluminum bridge section must be removed to provide a 1/2" minimum separation between interior and exterior metal surfaces.
3. The thermal barrier cavity shall have a manufactured mechanical lock applied consisting of abrading or lancing of the extrusion cavity prior to application of poured-in-place polyurethane.
4. Thermal Break Performance Requirements:
 - a. Shear strength: minimum 2,500 Lbf in accordance with (AAMA TIR-A8).
 - b. Flexural strength: minimum 19,000 psi in accordance with (AAMA D 790).
 - c. Thermal conductivity of barrier material: maximum 0.84 -in/(hr-ft²-°F) in accordance with (ASTM C 518).
 - d. Systems employing non-structural thermal barriers, or barrier systems absent of a mechanical lock application are not acceptable.

2.03 MANUFACTURED UNITS

- A. Principal window frame members shall have a minimum 0.090" outside wall thickness, and .078" mounting webs, and sectional flanges
- B. Window frame depth shall be 3 1/4" minimum.
- C. Glazing: Refer to Section 2.05 "GLASS MATERIALS".

2.04 COMPONENTS

- A. All fasteners, tools, equipment, and other materials necessary for a complete installation shall be furnished by the Contractor.
 1. Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be noncorrosive and compatible with all window members, cladding, trim, anchors, and other components.
- B. Thermoplastic or thermo-set plastic caps, housings, and other components to be injection-molded nylon, extruded PVC, or other suitable compound
- C. Accessories:
 1. Sills: Manufacturer's standard exterior sills, as shown on Drawings.
 - a. Sill Flashing: manufacturer's standard snap-on type, if required as shown on drawings.
 2. Trim: Manufacturer's standard interior snap trims, type as shown on Drawings.
 3. Mullions: Provide mullions and cover plates as shown, matching window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

2.05 GLASS MATERIALS:

- A. Tempered Glass: Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3, clear, fully tempered safety glass (meet requirements of ((ANSI Z97.1))).
 1. As specified in Section 08 8000 – Glazing and as selected from samples by Architect.
 2. Windows shall be glazed as follows:
 - a. Sound Transmission Class (STC) (((ASTM E413))) : Provide glazing required for conforming to over all STC ratings as specified for aluminum windows.
- B. Insulating Glass: Manufacturer's standard units that comply with specified quality standards and coatings.
 1. Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E774 for performance

classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, space material, and desiccants.

- a. Total Thickness: 1"
- b. Thickness of Each Pane: as necessary to meet structural performance criteria. or specify
- c. Air Space: argon gas filled or specify
2. Exterior Pane of Glass:
 - a. Provide tempered glass where shown on Drawings and as required by local codes and ordinances.
3. Insulated Unit Sealing System:
 - a. Insulating glass unit spacer system must include a secondary dual seal. This also applied to solid foam warm edge seal glass spacer systems.

2.06 FINISHES

2.07 FINISH OF ALUMINUM COMPONENTS

- A. Finish of all exposed areas of aluminum windows and components shall be applied in accordance with the appropriate AAMA Voluntary Guide Specification shown below:
 1. Electrolytically Deposited Anodic Coating, Class 1, Designation AAM12C21A44 conforming to (FGIA/((AAMA 611)))
 2. Finish Warranty: 5 years from date of manufacture
 3. Color Selection: (clear, champagne, light bronze, medium bronze, dark bronze, or black)

2.08 FABRICATION

- A. Fabricate windows allowing for minimum clearances and shim spacing around perimeter of assembly yet enabling installation.
- B. Rigidly fit joints and corners. Accurately fit and secure corners tight. Make corner joints flush, hairline, and weatherproof. Seal corner joints with sealant.
- C. Develop drainage holes with moisture pattern to exterior.
- D. Prepare components to receive anchor devices. Fabricate anchorage items.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:
 1. Verify that building substrates permit installation of windows according to the manufacturer's instructions, approved shop drawings, calculations and contract documents.
 2. Do not install windows until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Erection of Aluminum Windows
 1. Install windows with skilled tradesmen in exact accordance with approved Shop Drawings, Installation Instructions, Specifications, and in accordance with (FGIA/AAMA 101/I.S.2./A440).
 2. Windows must be installed plumb, square, and level for proper weathering and operation. Jambs must not be "sprung", bowed, or warped during installation.
 3. Any uncoated aluminum components of Aluminum Window shall be insulated from direct contact with steel, masonry, concrete, or other dissimilar metals by bituminous paint, zinc chromate primer, nonconductive shims, or other suitable insulating materials.

3.03 ADJUSTING AND CLEANING

- A. adjusted, put into working order and left clean, free of labels, dirt, or other debris. Protection from this point shall be the responsibility of the General Contractor.

END OF SECTION 08 51 13

This page intentionally left blank

**SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal grid or channel ceiling framing.
- C. Gypsum wallboard.
- D. Cementitious backing board.
- E. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- B. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- C. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- D. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- E. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- F. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- H. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- I. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Include data on metal framing, gypsum board, glass mat faced gypsum board, sheathing, accessories, and joint finishing system.
- C. Product Data: Include manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- E. Installer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.
- B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 WALL ASSEMBLY TYPES

- A. See drawings for graphic representations of assemblies.

2.02 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.

2.03 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Studs: "C" shaped with knurled or embossed faces.
 - a. Products:
 - 1) ClarkDietrich: www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
- C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and braced with continuous bridging both sides.
- D. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- E. Preformed Top Track Firestop Seal:
 - 1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

2.04 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. USG Corporation: www.usg.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Board: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 - 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold resistant board is required in restrooms.
 - 4. Thickness:
 - a. Vertical Surfaces: As indicated on drawings.
 - b. Ceilings: 1/2 inch.
 - 5. Paper-Faced Fire-Resistant Board Products:
 - a. USG Corporation; USG Sheetrock Brand Firecode SCX Panels 5/8 in: www.usg.com/#sle.
 - 6. Moisture- and Mold-Resistant Glass Mat-Faced Products:

- a. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough Firecode SGX 5/8 in: www.usg.com/#sle.
- C. Backing Board For Wet Areas:
 - 1. Application: Surfaces behind tile in wet areas including restrooms.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Glass Mat-Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
 - b. Products:
 - 1) USG Corporation; USG Durock Brand Glass-Mat Tile Backerboard SGX 5/8 in: www.usg.com/#sle.

2.05 GYPSUM WALLBOARD ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
- C. Wall Supported Ceilings: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Install indexed support bars when framing members spans exceed manufacturer's recommendations for the imposed loads; install at spacings recommended by manufacturer.
- D. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
- E. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- F. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.
- G. Blocking: Install wood blocking for support of:
 - 1. Wall-mounted cabinets.
 - 2. Plumbing fixtures.
 - 3. Toilet accessories.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

- D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09 21 16

**SECTION 09 24 00
CEMENT PLASTERING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cement plastering.

1.02 REFERENCE STANDARDS

- A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- B. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2023a.
- C. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Samples:
 - 1. Submit two samples, 24 by 24 inch in size illustrating finish color and texture.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.05 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Mock-Up Panel: Construct a 4 foot wide by 8 foot high sample panel of plaster work at the jobsite demonstrating installation procedures, finish texture, and color. Show each phase of installation including framing and reinforcement.
- C. Construct mock-up of exterior wall, 4 feet long by 4 feet wide, illustrating surface finish.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of this work.

1.06 FIELD CONDITIONS

- A. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F or lower, or when temperature is expected to drop below 40 degrees F within 48 hours of application.

PART 2 PRODUCTS

2.01 CEMENT PLASTER APPLICATIONS

- A. Lath Plaster Base: Metal lath.
 - 1. Plaster Type: Factory prepared plaster mix.
 - 2. Number of Coats: Three.
 - 3. First Coat: Apply to a nominal thickness of 3/8 inch.
 - 4. Second Coat: Apply to a nominal thickness of 3/8 inch.
 - 5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch.
 - 6. Finish Coat: Apply to a nominal thickness of 1/8 inch.
 - a. Texture: Provide 3 different options for Architect to select from; samples may be physical samples delivered to Architect's office or mock-ups in the field. Sample size to be minimum 24" x 24".

2.02 FACTORY PREPARED CEMENT PLASTER

- A. Exterior Portland cement plaster system made of scratch and brown base coat, leveling coat with reinforcing mesh, and acrylic finish coat; install in accordance with ASTM C926.

1. Provide weather resistive barrier as part of the system.

2.03 ACCESSORIES

- A. Lath:
 1. Wire Size: 17 gauge, 0.453 inch.
 2. Galvanized: ASTM A641/A641M.
 3. Opening Size: 11/16 by 1-1/2 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.

3.02 CONTROL JOINTS

- A. Locate as approved by Architect for visual effect and as follows:
 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft.
 2. At distances between control joints of not greater than 18 feet o.c.
 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 4. Where control joints occur in surface of construction directly behind plaster

3.03 INSTALLATION - WATER-RESISTIVE BARRIER

- A. Where cement plaster is installed as part of a barrier wall system, install two layers of water-resistive barrier in accordance with water-resistive barrier manufacturer's instructions.
- B. Integrate water-resistive barrier with flashing accessories, and adjacent doors, windows, penetrations, and cladding transitions.

3.04 INSTALLATION - RAINSCREEN DRAINAGE MATERIAL

- A. Install rainscreen drainage material and metal lath with accessories over sheathing material and water-resistive barrier with fastening system in accordance with ASTM C1063 into wood or metal studs. Install drainage material with filter fabric mortar screen to exterior.

3.05 MIXING

- A. Mix only as much plaster as can be used prior to initial set.
- B. Mix materials dry, to uniform color and consistency, before adding water.
- C. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.06 APPLICATION

- A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.
- B. Base Coats:
 1. Apply base coat(s) to fully embed lath and to specified thickness.
 2. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.
- C. Leveling Coat:
 1. Apply leveling coat to specified thickness.
- D. Finish Coats:
 1. Cement Plaster:

- a. Apply with sufficient material and pressure to ensure complete coverage of base to specified thickness.
- b. Apply desired surface texture while mix is still workable.

3.07 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet.

3.08 REPAIR

- A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

END OF SECTION 09 24 00

This page intentionally left blank

**SECTION 09 30 00
TILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 07 95 13 - Expansion Joint Cover Assemblies: Expansion joint components.
- C. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- C. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- D. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.
- E. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136, TCNA (HB), and TCNA (HB-GP) on-site.

- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on drawings.
 - 2. Approved mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products of each type by the same manufacturer.
 - 1. American Olean Corporation; _____: www.americanolean.com/#sle.
 - 2. Dal-Tile Corporation; _____: www.daltile.com/#sle.
 - 3. Emser Tile, LLC; _____: www.emser.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Glazed Wall Tile, Type GT-1: ANSI A137.1 standard grade.
- C. Porcelain Tile, Type PT-1: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: tbd inch, nominal.
 - 3. Thickness: tbd inch.
 - 4. Edges: Square.
 - 5. Surface Finish: tbd.
 - 6. Color(s): To be selected by Architect from manufacturer's full range.
 - 7. Trim Units: Matching bullnose shapes in sizes coordinated with field tile.
 - 8. Products:
 - a. Dal-Tile Corporation; Xteriors: www.daltile.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Porcelain Tile, Type PT-2: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: 4 x 8 (field cut 8 x 8) inch, nominal.
 - 3. Thickness: 3/8 inch.
 - 4. Edges: Cushioned.
 - 5. Surface Finish: Matte glazed.
 - 6. Color(s): Ocrea.
 - 7. Pattern: refer to drawings.
 - 8. Products:
 - a. Dal-Tile Corporation; Quartetto: www.daltile.com/#sle.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Porcelain Tile, Type PT-3: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: 8 by 8 inch, nominal.
 - 3. Thickness: 3/8 inch.
 - 4. Edges: Cushioned.
 - 5. Surface Finish: Matte glazed.
 - 6. Color(s): Warm Grand Fiore QU12.
 - 7. Pattern: refer to drawings.
 - 8. Products:
 - a. Dal-Tile Corporation; Quartetto: www.daltile.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SETTING MATERIALS

2.03 GROUTS

END OF SECTION 09 30 00

This page intentionally left blank

**SECTION 09 51 13
ACOUSTICAL CEILINGS**

PART 1 – GENERAL

1.01 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.

1.02 SUMMARY

- A. Section Includes
 - 1. Acoustical ceiling panels
 - 2. Exposed grid suspension system
 - 3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
 - 4. Perimeter Trim

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. Related Sections
 - 1. Section 09 50 00 - Ceilings
 - 2. Section 09 51 14 – Acoustical Fabric Faced Panel Ceilings
 - 3. Section 09 51 23 – Acoustical Tile Ceilings
 - 4. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
 - 5. Section 09 20 00 - Plaster and Gypsum Board
 - 6. Section 01 81 13 - Sustainable Design Requirements
 - 7. Section 01 81 19 - Indoor Air Quality Requirements
 - 8. Section 02 42 00 - Removal and Salvage of Construction Materials
 - 9. Division 23 - HVAC Air Distribution
 - 10. Division 26 - Electrical
- E. ALTERNATES
 - 1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been pre-approved by the architect and included in the Addenda, the originally specified products shall be provided without additional compensation.
 - 2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers; Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
 7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
 10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
 11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
 12. ASTM E 1264 Classification for Acoustical Ceiling Products
- B. International Building Code
- C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality
- D. NFPA 70 National Electrical Code
- E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- G. International Code Council-Evaluation Services Report - Seismic Engineer Report
1. ESR 1308 - Armstrong Suspension Systems
- H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report
1. 0244 - Armstrong Single Span Suspension System
- I. California Department of Public Health CDPH/EHLB/Standard Method v1.2 2017
- J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings
- K. International Well Building Standard
- L. Mindful Materials
- M. Living Building Challenge
- N. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).
- O. Clean Rooms up to ISO Class 5 (Class 100)

1.05 SYSTEM DESCRIPTION

- A. Continuous/Wall-to-wall

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
- B. Samples: Minimum 6-inch x 6-inch samples of specified acoustical panel; 8-inch-long samples of exposed wall molding and suspension system, including main runner and 4-foot cross tees.

- C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with or supported by the ceilings.
- D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification, such as Underwriter's Laboratory (UL), of NRC, CAC, and AC.
 - 1. If the material supplied by the acoustical subcontractor does not have an independent laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of, and replaced with complying product at the expense of the Contractor performing the work.

1.07 SUSTAINABLE MATERIALS

- A. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.
 - 1. Health Product Declaration (HPD). The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration Open Standard.
 - 2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).
 - 3. Low Emitting products with VOC emissions data. Preference will be given to manufacturers that can provide emissions data showing their products meet any of the following: CDPH/EHLB/Standard Method v1.2-2017; Indoor Air Quality Certified to SCS-105 v4.2-2023
 - 4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.
 - 5. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.
 - 6. Products meeting LEED V4 requirements including:
 - a. Storage & Collection of Recyclables
 - b. Construction and Demolition Waste Management Planning
 - c. Building Life-Cycle Impact Reduction
 - d. Building Product Disclosure and Optimization Environmental Product Declarations
 - e. Building Product Disclosure and Optimization Sourcing of Raw Materials
 - f. Building Product Disclosure and Optimization Material Ingredients
 - g. Construction and Demolition Waste Management

1.08 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer to ensure fit and function.
- B. Installer Qualifications: Company specializing in performing specified work type, a minimum of three years of documented experience, and approved by the manufacturer.
- C. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

- D. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.10 PROJECT CONDITIONS

- A. Space Enclosure:
 - 1. HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless-steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.11 ALTERNATE CONSTRUCTION WASTE DISPOSAL

- A. Ceiling material being reclaimed must be kept dry and free from debris.
- B. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will help facilitate the process to recycle the ceiling.
- C. Recycling may qualify for LEED Credits:
 - 1. LEED 2009 - Category 4: Material and Resources (MR)
 - a. Credit MRc2: Construction Waste Management
 - 2. LEEDv4 - MRp2
 - a. Construction Waste Management Planning Qualifies as a material stream (non-structural) targeted for diversion. Ceilings will be source-separated and diverted through the Armstrong Ceiling Recycling Program.
 - 3. LEEDv4-MRc5
 - a. Option 1: Divert ceilings to qualify for one of the 3 material streams (50%)
 - b. Option 2: Divert ceilings to qualify for one of the 4 material streams (75%)

1.12 WARRANTY

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
 - 1. Acoustical Panels with HumiGuard® Max and HumiGuard® Plus performance: sagging and warping
 - 2. Acoustical panels with BioBlock® performance: growth of mold and mildew
 - 3. Grid System: rusting and manufacturer's defects
- B. Warranty Period:
 - 1. Ceiling System: Thirty (30) years from date of substantial completion
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.13 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Ceiling Panels:
 - 1. Armstrong World Industries, Inc.
- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc.

ACOUSTICAL CEILING UNITS

- A. Acoustical Panel Ceilings
 - 1. Surface Texture: Medium Texture
 - 2. Composition: Mineral Fiber
 - 3. Color: White
 - 4. Size: 24 in x 24 in
 - 5. Edge Profile: Square Lay-in
 - 6. Noise Reduction Coefficient (NRC) ASTM C 423 Classified w/ UL label on product carton: 0.55
 - 7. Ceiling Attenuation Class (CAC): ASTM E1414/E1414M; Classified with UL label on product carton: 33, 35
 - 8. Flame Spread: ASTM E 1264; Class A
 - 9. Light Reflectance (LR) White Panel: ASTM E 1477; 0.85
 - 10. Dimensional Stability: Standard, HumiGuard Plus
 - 11. Recycle Content: Up to 73% total recycled content. (Total recycled content: pre-consumer, post-consumer and post-industrial)
 - 12. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
 - 13. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)
 - 14. Indoor Air Quality Certified to SCS-105 v4.2-2023
 - 15. Basis of Design: FINE FISSURED, item number 1732 , as manufactured by Armstrong World Industries, Inc.
 - 16. Substitutions: Refer to Alternates in Part 1.

3.02 METAL SUSPENSION SYSTEMS

- A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
 - 1. Structural Classification: ASTM C 635 Intermediate or Heavy Duty.
 - 2. Color: White or match the actual color of the selected ceiling tile, unless noted otherwise.
 - 3. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
 - 4. Basis of Design (select one to work with specified ceiling):
 - a. Prelude XL 15/16" Exposed Tee as manufactured by Armstrong World Industries, Inc.

5. Substitutions: Refer to Alternates in Part 1.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.
- D. Edge Moldings and Trim as manufactured by Armstrong World Industries, Inc.
- E. Accessories as manufactured by Armstrong World Industries, Inc.

PART 3 – EXECUTION

4.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

INSTALLATION

- A. Follow manufacturer installation instructions.
- B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
- C. Suspend main beam from overhead construction with hanger wires spaced 4 feet on center along the length of the main runner. Install hanger wires plumb and straight.
- D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
- E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
- F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 51 15
ACOUSTICAL CEILINGS - CALLA

PART 1 – GENERAL

1.01 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.

1.02 SUMMARY

- A. Section Includes
 - 1. Acoustical ceiling panels
 - 2. Exposed grid suspension system
 - 3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
 - 4. Perimeter Trim

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. Related Sections
 - 1. Section 09 50 00 - Ceilings
 - 2. Section 09 51 14 – Acoustical Fabric Faced Panel Ceilings
 - 3. Section 09 51 23 – Acoustical Tile Ceilings
 - 4. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
 - 5. Section 09 20 00 - Plaster and Gypsum Board
 - 6. Section 01 81 13 - Sustainable Design Requirements
 - 7. Section 01 81 19 - Indoor Air Quality Requirements
 - 8. Section 02 42 00 - Removal and Salvage of Construction Materials
 - 9. Division 23 - HVAC Air Distribution
 - 10. Division 26 - Electrical
- E. ALTERNATES
 - 1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been pre-approved by the architect and included in the Addenda, the originally specified products shall be provided without additional compensation.
 - 2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers; Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
 7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
 10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
 11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
 12. ASTM E 1264 Classification for Acoustical Ceiling Products
- B. International Building Code
- C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality
- D. NFPA 70 National Electrical Code
- E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- G. International Code Council-Evaluation Services Report - Seismic Engineer Report
1. ESR 1308 - Armstrong Suspension Systems
- H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report
1. 0244 - Armstrong Single Span Suspension System
- I. California Department of Public Health CDPH/EHLB/Standard Method v1.2 2017
- J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings
- K. International Well Building Standard
- L. Mindful Materials
- M. Living Building Challenge
- N. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).
- O. Clean Rooms up to ISO Class 5 (Class 100)

1.05 SYSTEM DESCRIPTION

- A. Continuous/Wall-to-wall

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
- B. Samples: Minimum 6-inch x 6-inch samples of specified acoustical panel; 8-inch-long samples of exposed wall molding and suspension system, including main runner and 4-foot cross tees.

- C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with or supported by the ceilings.
- D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification, such as Underwriter's Laboratory (UL), of NRC, CAC, and AC.
 - 1. If the material supplied by the acoustical subcontractor does not have an independent laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of, and replaced with complying product at the expense of the Contractor performing the work.

1.07 SUSTAINABLE MATERIALS

- A. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.
 - 1. Health Product Declaration (HPD). The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration Open Standard.
 - 2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).
 - 3. Low Emitting products with VOC emissions data. Preference will be given to manufacturers that can provide emissions data showing their products meet any of the following: CDPH/EHLB/Standard Method v1.2-2017; Indoor Air Quality Certified to SCS-105 v4.2-2023
 - 4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.
 - 5. Biobased products derived from plants and other renewable materials will be given preference. Provide USDA Certified Biobased Product certification.
 - 6. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.
 - 7. Products meeting LEED V4 requirements including:
 - a. Storage & Collection of Recyclables
 - b. Construction and Demolition Waste Management Planning
 - c. Building Life-Cycle Impact Reduction
 - d. Building Product Disclosure and Optimization Environmental Product Declarations
 - e. Building Product Disclosure and Optimization Sourcing of Raw Materials
 - f. Building Product Disclosure and Optimization Material Ingredients
 - g. Construction and Demolition Waste Management

1.08 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer to ensure fit and function.
- B. Installer Qualifications: Company specializing in performing specified work type, a minimum of three years of documented experience, and approved by the manufacturer.

- C. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
- D. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.10 PROJECT CONDITIONS

- A. Space Enclosure:
 - 1. HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless-steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.11 ALTERNATE CONSTRUCTION WASTE DISPOSAL

- A. Ceiling material being reclaimed must be kept dry and free from debris.
- B. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will help facilitate the process to recycle the ceiling.
- C. Recycling may qualify for LEED Credits:
 - 1. LEED 2009 - Category 4: Material and Resources (MR)
 - a. Credit MRc2: Construction Waste Management
 - 2. LEEDv4 - MRp2
 - a. Construction Waste Management Planning Qualifies as a material stream (non-structural) targeted for diversion. Ceilings will be source-separated and diverted through the Armstrong Ceiling Recycling Program.
 - 3. LEEDv4-MRc5
 - a. Option 1: Divert ceilings to qualify for one of the 3 material streams (50%)
 - b. Option 2: Divert ceilings to qualify for one of the 4 material streams (75%)

1.12 WARRANTY

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
 - 1. Acoustical Panels with HumiGuard® Max and HumiGuard® Plus performance: sagging and warping
 - 2. Acoustical panels with BioBlock® performance: growth of mold and mildew
 - 3. Grid System: rusting and manufacturer's defects
- B. Warranty Period:
 - 1. Ceiling System: Thirty (30) years from date of substantial completion

- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.13 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Ceiling Panels:
1. Armstrong World Industries, Inc.
- B. Suspension Systems:
1. Armstrong World Industries, Inc.

ACOUSTICAL CEILING UNITS

- A. Acoustical Panel Ceilings
1. Surface Texture: Smooth Texture
 2. Composition: Mineral Fiber
 3. Color: White
 4. Size: 24 in x 24 in
 5. Edge Profile: Square Tegular.
 6. Noise Reduction Coefficient (NRC) ASTM C 423 Classified w/ UL label on product carton: 0.85
 7. Ceiling Attenuation Class (CAC): ASTM E1414/E1414M; Classified with UL label on product carton: 35
 8. Articulation Class (AC): ASTM E 1111; Classified with UL label on product carton: 170
 9. Flame Spread: ASTM E 1264; Class A
 10. Light Reflectance (LR) White Panel: ASTM E 1477; 0.85
 11. Dimensional Stability: HumiGuard Plus
 12. Recycle Content: Up to 76% total recycled content. (Total recycled content: pre-consumer, post-consumer and post-industrial)
 13. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
 14. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)
 15. Indoor Air Quality Certified to SCS-105 v4.2-2023
 16. USDA Certified Biobased Product
 17. Basis of Design: Calla, item number 2822, as manufactured by Armstrong World Industries, Inc.
 18. Substitutions: Refer to Alternates in Part 1.

3.02 METAL SUSPENSION SYSTEMS

- A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
1. Structural Classification: ASTM C 635 Intermediate or Heavy Duty.
 2. Color: White or match the actual color of the selected ceiling tile, unless noted otherwise.

3. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
4. Basis of Design (select one to work with specified ceiling):
 - a. Silhouette XL 9/16" in Bolt Slot (1/4" reveal) as manufactured by Armstrong World Industries, Inc.
5. Substitutions: Refer to Alternates in Part 1.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.
- D. Edge Moldings as manufactured by Armstrong World Industries, Inc.
- E. AXIOM Trim & Transitions as manufactured by Armstrong World Industries, Inc.
www.armstrongceilings.com/axiom
- F. Accessories as manufactured by Armstrong World Industries, Inc.

PART 3 – EXECUTION

4.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

INSTALLATION

- A. Follow manufacturer installation instructions.
- B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
- C. Suspend main beam from overhead construction with hanger wires spaced 4 feet on center along the length of the main runner. Install hanger wires plumb and straight.
- D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
- E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
- F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.

- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION 09 51 15

This page intentionally left blank

SECTION 09 51 26
WOOD VENEERED CEILING PANELS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 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.

1.03 SUMMARY

- A. Section Includes:
 - 1. WoodWorks Grille-Forté Veneered Wood Ceiling Panels with Centered Notched and Flat Backers
 - 2. Exposed grid suspension system.
 - 3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.
- B. Related Sections:
 - 1. Section 09 53 00 - Acoustical Ceiling Suspension Assembly
 - 2. Section 09 20 00 - Plaster and Gypsum Board
 - 3. Section 09 22 16 - Non-Structural Metal Framing
 - 4. Divisions 23 (15) - HVAC
 - 5. Division 26 (16) Sections - Electrical Work
- C. Alternates
 - 1. Prior Approval: Unless otherwise provided for in the Contract documents, submit proposed product substitutions no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review and acceptance. Approved products will be set forth by the Addenda. If a substitution is included in a Bid and is not approved by an Addendum, the specified products shall be provided as in place of the substitute without additional compensation.
 - 2. Submittals, which do not provide adequate data for the product evaluation, will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); panel design, size, composition, color, and finish; suspension system component profiles and sizes; compliance with the referenced standards.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 3. ASTM A 1008 Standard Specification for Steel, Sheet, and Cold Rolled Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 4. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
6. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
7. ASTM E 580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
8. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
9. ASTM E 1264 Classification for Acoustical Ceiling Products.
10. Hardwood Plywood & Veneer Association (HPVA)
11. International Building Code
12. ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality
13. NFPA 70 National Electrical Code
14. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
15. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
16. International Code Council-Evaluation Services Report - Seismic Engineer Report
 - a. ESR 1308 - Armstrong T-Bar or Dimensional Suspension
17. California Air Resources Board (CARB) compliant
18. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.05 SUBMITTALS

- A. Shop Drawings: Layout and details of ceilings. Show locations of items that are to be coordinated with or supported by the ceilings.
- B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part three, Installation.
- C. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- D. Samples: 4-1/4"x 7"x 3/4" – Real Wood Veneer on fire rated particle board– Semi-gloss tinted topcoat – Clear Finish
- E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- F. Non-Conformance: All products not conforming to the requirements of this specification and or the manufacturer's published values are to be disposed. The Contractor performing the work will replace with approved product at their expense.

1.06 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 1. Surface Burning Characteristics: As follows, tested per ASTM E-84 and complying with ASTM E 1264 for Class A products.
 2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.
- C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical

systems, and sprinklers.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees Fahrenheit or greater than 86 degrees Fahrenheit. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.08 PROJECT CONDITIONS

- A. Wood ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).
- B. The wood panels should not be installed in spaces where the temperature or humidity conditions vary from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the veneered panels are designed for installation in temperature conditions between 50 degrees Fahrenheit and 86 degrees Fahrenheit, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.09 WARRANTY

- A. Veneered Wood Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Veneered Wood Panels: Defects in materials or factory workmanship.
 - 2. Grid System: Rusting and manufacturing defects.
- B. Warranty Period:
 - 1. Veneered Wood panels: One (1) year from date of installation.
 - 2. Grid: Ten years from date of installation.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.10 9 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design WoodWorks Grille - Forte' Veneered Ceilings Panels:
 - 1. Armstrong World Industries, Inc.
- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc.

2.02 WOOD CEILING UNITS

- A. Ceiling Panels Type **WS-1**:
1. Surface Texture: Smooth
 2. Composition: Real wood veneer on fire rated particle board
 3. Finish(s): Real Wood Veneer
 - a. Plain Slice White Maple (NWM)
 - b. Plain Slice White Ash (NWA)
 - c. Plain Slice White Oak (NOK)
 - d. Plain Slice Cherry (NPC)
 - e. Plain Slice Walnut (NWN)
 - f. Quartered Mahogany (NQM)
 - g. Quartered Sapele (NQS)
 - h. Quartered Walnut (NQW)
 - i. Rift White Oak (NRO)
 - j. Vertical Grain Fir (NVF)
 - 1) Custom finishes available
 4. Panel Width: 12-inch
 - a. Panel Length Size(s): With 1" reveal panel to panel @ length
 - b. 48-inch (Nominal): 47-inch (Actual)
 - c. 72-inch (Nominal): 71-inch (Actual)
 - d. 96-inch (Nominal): 95-inch (Actual)
 - e. Slat Width 3/4-inch:
 - 1) Height – Number of Slats (Spacing) item#
 - (a) 4" – 3 Slats (3-1/4") 6333L_S17---
 5. Flame Spread:
 - a. Class A: ASTM E84 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less.
 - b. CAN/ULC S102 surface burning characteristics. Flame Spread Rating 25 or less. Smoke Developed Classification 50 or less.
 6. Acceptable Product: WoodWorks Grille Forté Veneered Panels –items 6333L_S17, as manufactured by Armstrong World Industries.
 7. Please use ordering format found on our data page:
- B. Accessories:
1. Backer Clip - item 5687
 2. Flat Backer Kit - item 7920GBL
 3. Heavy Duty Wall Anchor – item 7100

2.03 SUSPENSION SYSTEMS

- A. Components: All main beams and cross tees shall be commercial quality hot dipped galvanized steel as per ASTM A653. Main beams and cross tees are double-web steel construction with 15/16-inch type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
1. Structural Classification: ASTM C635 (Heavy Duty).
 2. Color: Tech Black.
 3. Acceptable Product: Prelude XL 15/16" Exposed Tee Main beam item 7301BL, Prelude XL Exposed Tee item XL7341BL, Prelude XL Exposed Tee 2' item XL7328BL as manufactured by Armstrong World Industries, Inc.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

- C. Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least times-three design load, but not less than 12 gauge.
- D. Accessories/Edge Moldings and Perimeter Trim:
 - 1. 7/8" Angle Wall Molding - item 7800BL
 - 2. 4" Veneered Trim with 4 Clips – item 6481F07W1H4---(Finish Suffix)
 - 3. 6" Veneered Trim with 4 Clips – item 6481F07W1H6---(Finish Suffix)
 - 4. 8" Veneered Trim with 4 Clips – item 6481F07W1H8---(Finish Suffix)
 - 5. Replacement Trim Clip – item 5925
 - 6. Adjustable Trim Clip – item 7239
 - 7. Axiom Vector Straight Trim - Recommend in Black 6" and up – AX_STR (Finish)
 - 8. Axiom Vector Curved Trim - Recommend in Black 6" and up – AX_Cur (Finish)
 - 9. WoodWorks Edgebanding – item 6408---(Finish Suffix)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. WoodWorks ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).

3.03 INSTALLATION

- A. Interior WoodWorks products, the veneered wood panels are designed for installation in temperature conditions between 50 degrees Fahrenheit and 86 degrees Fahrenheit, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.
- B. Install suspension system and panels in compliance with ASTM C636, ASTM E580, with the approval of the authorities having jurisdiction, and in accordance with the manufacturer's WoodWorks Grille Forté Veneered Installation Instructions.

3.04 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

END OF SECTION 09 51 26

This page intentionally left blank

**SECTION 09 65 13
RESILIENT WALL BASE**

PART 1 – GENERAL

1.01 GENERAL PROVISIONS

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

1.02 SUMMARY

- A. Section includes:
 - 1. Resilient Wall Base

1.03 SUBMITTALS, RELATED DOCUMENTS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- B. Product Data: Submit manufacturers documentation for each material and accessory proposed for use (available at www.roppe.com).
 - 1. Technical data sheet
 - 2. Care & maintenance document
 - 3. Warranty
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated, in manufacturer's standard- size samples of each resilient product color, texture and pattern required.
- E. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide resilient wall base materials manufactured in the United States of America by a firm with a minimum of 10 years' experience with resilient vinyl materials of type equivalent to those specified.
- B. Provide resilient wall base, flooring materials, adhesives, accessories and subfloor preparation products from one manufacturer to ensure color matching and compatibility.
- C. Manufacturer shall be capable of providing technical training and technical field service representation.

1.05 RELATED WORK

- A. Installer must be professional, licensed, insured and acceptable to manufacturer of resilient flooring materials. Project Managers or Field Supervisors must be INSTALL (International Standards & Training Alliance) certified CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager) for the requirements of the project or equivalent.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within the range recommended by Roppe of 65 degrees F (18degrees C) and 85 degrees F (29 degrees C).

1.07 PROJECT CONDITIONS

- A. Install resilient product s after other finishing operations, including painting, have been completed.
- B. Maintain ambient temperatures within range of (± 10 degrees F) 65 degrees (18 degrees C) and 85 degrees F (29 degrees C) in the spaces to receive the resilient products during:
 - 1. 48 hours before installation.

2. During installation.
3. 48 hours after installation.
- C. Maintain relative humidity between 40% and 65% during installation.
- D. Avoid conditions in which dew point causes condensation on the installation surface.

1.08 WARRANTY

- A. Provide manufacturer's standard limited commercial warranty to cover manufacturing defects

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Basis-of-Design: Roppe Corporation | 1602 N Union St. | Fostoria, OH 44830 | P: (800) 537-9527
- B. Substitutions: permitted as per Substitutions Procedures specifications section

2.02 PRODUCTS

- A. ROPPE THERMOPLASTIC VINYL (TV) WALL BASE specify - specify vinyl wall base with the following characteristics: Meets the performance requirements for the following Industry Standards:
 1. ASTM F1861, Standard Specification for Resilient Wall Base, Type TV (vinyl, thermoplastic), Group 2 (solid, layered), Style A&B (Straight, Cove)
 2. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, Class A
 3. ASTM E648 (NFPA 253), Standard Test Method for Critical Radiant Flux, Class 1, >0.45 W/cm²
 4. ASTM E662 (NFPA 258), Standard Test Method for Smoke Density, Passes, <450
 5. ASTM F137, Standard Test Method for Flexibility of Resilient Flooring Materials protocols, Passes
 6. ASTM F386, Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces, Passes
 7. ASTM F925, Standard Test Method for Resistance to Chemicals of Resilient Flooring, Excellent
 8. ASTM F1515, Standard Test Method for Measuring Light Stability of Resilient Flooring protocols, Passes
 9. NFPA 253, Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source
 10. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
 11. NFPA 258, Test Method for Specific Density of Smoke Generated by Solid Materials
- B. Description:
 1. Roppe 4" Vinyl Cove Base
 2. Color: To be selected from Manufacturer's Full Range
- C. Other Criteria:
 1. TV WALL BASE vinyl wall base is SCS FloorScore® Certified and meets California Specifications Section 01350
 2. TV WALL BASE vinyl wall base is 100% recyclable
 3. TV WALL BASE vinyl wall base and accessories do not contain chemicals that may be hazardous to human health
 4. TV WALL BASE vinyl wall base meets NSF 332 Gold Criteria
 5. TV WALL BASE vinyl wall base meets CHPS Criteria
 6. TV WALL BASE vinyl wall base is manufactured in the U.S.A.

7. TV WALL BASE vinyl wall base is free of materials known to be teratogenic, mutagenic or carcinogenic
8. TV WALL BASE vinyl wall base is free of Halogens
9. TV WALL BASE vinyl wall base is free of Asbestos
10. TV WALL BASE vinyl wall base is free of Phthalates
11. TV WALL BASE vinyl wall base is free of Heavy Metals

2.03 INSTALLATION AND MAINTENANCE MATERIALS

- A. Substrate/Background Preparation Products:
 1. Adhesives: Adhesives should be selected based on the site conditions and use of the space being installed
- B. Recommended Adhesive Products:
 1. Excelsior WB-600 Acrylic Wall Base Adhesive by Roppe
 - a. Unit Size: 30 oz. cartridge, 1 Gallon & 4 Gallon
 - b. Coverage: 30 – 70 linear feet per cartridge, 180 – 340 linear feet per gallon
 - c. Standard installations over porous backgrounds
 - d. 100 % solids, solvent free and low VOCs
 - e. Hard set adhesive adding to dimensionally stable materials
 - f. Excellent sheer strength
 2. Excelsior C-630 Contact Adhesive provided by Roppe
 - a. Unit Size: 1 Quart
 - b. Coverage: 20 – 40 Square Feet per unit / 120 – 140 Linear Feet per unit
 - c. Standard installations over porous and non-porous substrates
 - d. Hard set adhesive adding to dimensionally stable materials
 - e. Excellent sheer strength
 - f. Superior bond strength
 - g. Great for environments with topical moisture
- C. Accessories: Items needed to complete the installation. Recommended accessory products:
 1. Inside corners
 2. Outside corners
 3. Color-matched caulks
- D. Maintenance Materials: Proper maintenance of the installation is critical to the long term performance of the flooring products being specified. Using the appropriate chemicals to maintain the product according to the environment in which it is specified is critical. Recommend maintenance products:
 1. Excelsior NC-900, All-Purpose Neutral pH Cleaner provided by Roppe
 - a. For initial maintenance
 - b. For daily and routine maintenance
 2. Excelsior FR-920 Finish Remover
 - a. For removing of topically applied finishes.
 - b. Highly concentrated, cuts through multiple layers of floor finish.

PART 3 – EXECUTION

3.01 GENERAL

- A. General Contractor Responsibilities:
 1. Supply a safe, climate controlled building as detailed in Roppe Technical Data Sheets.
 2. Ensure substrate/background meets the requirements of ASTM F1861, Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
 3. Provide a secure storage area that is maintained permanently or temporarily at normal operating temperature and humidity conditions between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of

- the wall base, so the contractor can acclimate the vinyl base materials per manufacturer's instructions.
4. Provide an installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity. Normal operating temperature and humidity conditions are between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the wall base per the manufacturer's instructions.
 5. Ensure areas with direct prolonged exposure to sunlight are protected with protective UVA/UVB restrictive coatings or films.
 6. In areas where the walls are subject to direct sunlight through doors or windows, the doors and windows should be covered using blinds, curtains, cardboard or similar for the time of the installation and 72-hours after the installation to allow the adhesive to cure. Note: These areas should be installed using wet adhesives only.
 7. Conduct initial maintenance prior to final usage per the Roppe Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.
 8. Provide trained installers that are professional, licensed, insured and acceptable to manufacturer of resilient vinyl wall base materials.
 9. Ensure installers or installation teams meet one of the following requirements:
 - a. Have completed INSTALL (International Standards & Training Alliance)
 - b. CFI (Certified Floorcovering Installers) training programs
 - c. Certified by INSTALL or CFI.
 - d. Are being supervised by Project Managers or Field Supervisors that are INSTALL (International Standards & Training Alliance) certified, CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager).
 10. Follow all requirements in the appropriate Roppe and/or Excelsior Technical Data Sheets, Care & Maintenance Documents, Warranties and other technical documents or instructions.

3.02 EXAMINATION

- A. General: Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and Preparation, as well as Section 01 43 00 – Quality Assurance.
- B. Verification of Conditions: Inspect all substrates/backgrounds to ensure they are clean, smooth, permanently dry, structurally sound and without voids. Confirm all areas are properly sealed and acclimated per manufacturer's requirements.
- C. Verification of Products: In accordance with manufacturer's installation requirements, visually inspect material for size, style, color or visual defects prior to installing. Any material that is incorrect or visually defective shall not be installed.

3.03 SUBSTRATE/BACKGROUND PREPARATION

- A. General: Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and preparation. All work required ensuring substrate/background meets manufacturers' guidelines are the responsibility of the general contractor.
- B. Preparation: Ensure substrate/background meets the requirements of ASTM F1861 for resilient wall base and/or Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
 1. Substrates/backgrounds must be free of visible water or moisture, dust, sealers, paint, residual adhesives and adhesive removers, solvents, wax, oil, grease, mold, mildew and any other extraneous coating, film, material or foreign matter.
 2. Acclimate all products to be used during the installation and the installation environment prior to installation according to the manufacturers written instructions.
 3. Fill cracks, holes, depressions and irregularities in the substrate/background to prevent transferring through to the surface of the resilient wall base.

3.04 INSTALLATION

- A. General: Follow all relevant guidelines detailed in Division 01, as well as wall base and adhesive manufacturer's technical data sheets.
- B. Resilient Vinyl Wall Base: Install material in accordance with manufacturer's recommendations.
 - 1. Select the appropriate adhesive for the application and job site conditions.
 - 2. Install material according to roll sequence or with like run numbers.
 - 3. Ensure material is rolled appropriately into the adhesive using a hand roller.

3.05 CLEANING & MAINTENANCE

- A. General: Clean up installation area and vacuum dust or wipe material to remove any dirt, dust or debris.
- B. Initial Maintenance: Conduct initial maintenance per the manufacturer's recommended procedures stated in the Maintenance Documents. All documentation is available upon request or from the Roppe website. Excelsior Cleaning products are the recommended products for use. All can be found linked to the product on the Roppe website or at www.excelsiorproducts.net.
- C. Regular Maintenance: Conduct maintenance on regular intervals as needed. Insufficient cleaning will reduce the wear life of the wall base and alter the aesthetic properties of the wall base. The amount of maintenance depends directly upon the amount of dirt and particulates the area is subjected to.

3.06 CLOSEOUT ACTIVITIES

- A. General: Follow all federal, state and local requirements and Division 01 Section 01 76 00 – Protecting Installed Construction and Section 01 78 00 – Closeout Submittal requirements for these activities, protecting installed construction.
- B. Protection: Protect newly installed material from damage by other trades. Be sure all construction debris is picked up and vacuumed or removed prior to leaving the area. Limit usage and foot traffic according to the adhesive's requirements. When moving appliances or heavy furniture, protect wall base from scuffing and tearing using temporary floor protection as well.

END OF SECTION 09 65 13

This page intentionally left blank

SECTION 09 81 16
ACOUSTIC BLANKET INSULATION

PART 1 — GENERAL

1.01 SUMMARY

- A. Section Includes: Glass fiber acoustical blanket insulation for interior partitions.
- B. Related Sections:
 - 1. Section 07 21 00 - Mineral Wool Insulation.
 - 2. Section 07 21 16 - Glass Fiber Batt Insulation.
 - 3. Section 07 21 18 - Glass Fiber Blanket Insulation.

1.02 SUBMITTALS

- A. Product Data: Submit product characteristics, performance criteria, and limitations, including installation instructions.
- B. Sustainable Design: Submit manufacturer's sustainable design certifications as specified with each product.

1.03 QUALITY ASSURANCE

- A. Mock-Up: If requested, provide a mock-up of materials proposed for use for review of workmanship. Accepted mock-ups may remain in place.
- B. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing work of this section. Agenda shall include materials proposed for use, sequence of construction and coordination with installation of adjacent and covering materials.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to the job site in original packages, containers, or bundles bearing the brand name and manufacturer's identification.
- B. Storage: Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling.
- C. Handling: Handle using procedures recommended by the manufacturer for materials and personnel.

1.05 WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty against manufacturing defects.

PART 2 — PRODUCTS

2.01 MANUFACTURER

- A. Basis-of-Design Manufacturer: Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.

2.02 ACOUSTIC BLANKET INSULATION (SOUND ATTENUATION BATTS), FIRE-RATED (METAL FRAMING)

- A. Type: Unfaced glass-fiber acoustical insulation, complying with ASTM C665, Type I.
 - 1. Thickness: 3 1/2 inches (89 mm).
 - 2. Width: 24 inches (406 to 609 mm).
 - 3. Length: 96 inches (2438 mm).
- B. Surface Burning Characteristics: ASTM E84.
 - 1. Maximum flame spread: <25
- C. Maximum smoke developed: <50
- D. Combustion Characteristics: Passes ASTM E136.
- E. Fire Resistance Ratings: Part of ASTM E119 fire tested wall assemblies.

- F. Sound Transmission Class: ASTM C423, STC based on manufacturer's published data on thickness and wall assembly.
- G. Dimensional Stability: Linear Shrinkage less than 0.1%

PART 3 — EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this section will be installed. Verify that adjacent materials are dry and ready to receive insulation. Verify mechanical and electrical services within walls have been tested and inspected.
- B. Provide written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's installation instructions. Do not use unfaced insulation in exposed applications where there is potential for skin contact and irritation. Friction-fit blanket insulation in place, until the interior finish is applied. Install batts to fill entire stud cavity, with no gaps, voids, or areas of compression. If stud cavity is less than 8 feet in height, cut lengths to friction fit against floor and ceiling tracks. Walls with penetrations require that insulation be carefully cut to fit around outlets, junction boxes, and other irregularities.
- B. Where walls are not finished on both sides or where insulation does not fill the cavity depth, install supplementary support to hold product in place.
- C. Where insulation must extend higher than 8 feet, provide temporary support to hold product in place, until finish material is applied.

3.03 PROTECTION

- A. Protect installed insulation from damage due to weather and physical abuse until protected by permanent construction.

END OF SECTION 09 81 16

SECTION 09 84 00
TECTUM DIRECT ATTACH PANELS

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section Includes:
 - 1. Cementitious wood fiber plank acoustical wall and ceiling system
- B. Related Sections:
 - 1. Section 09 20 00 – Plaster and Gypsum Board
 - 2. Section 01 81 13 – Sustainable Design Requirements
 - 3. Section 01 81 19 – Indoor Air Quality Requirements
 - 4. Divisions 23 – HVAC Air Distribution
 - 5. Division 26 – Electrical
- C. Alternates
 - 1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and compliance with the basis of design.
 - 2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.03 REFERENCES

- 1. American Society for Testing and Materials (ASTM)
- 2. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- 3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- 4. ASTM E2768-11(2018) Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials
- 5. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
- 6. ASTM C636 / C636M - 19 Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
- 7. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board
- 8. ASTM E 1264 Classification for Acoustical Ceiling Products
- 9. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- B. International Building Code
- C. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"
- D. NFPA 70 National Electrical Code
- E. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.1 2010

- F. L.E.E.D. - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings
- G. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- H. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- I. International Well Building Standard
- J. Mindful Materials
- K. Living Building Challenge
- L. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

1.04 SYSTEM DESCRIPTION

- A. Direct attached acoustical (Wall or ceiling) systems manufactured from domestic cementitious wood fiber.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of Tectum® Direct-Attached™ ceilings or walls required.
- B. Samples: Minimum 12-inch x 12-inch samples of specified Tectum® High NRC Direct-Attached interior panels.
- C. Shop Drawings: Layout and details of Tectum® Direct-Attached interior panels show locations of items that are to be coordinated with the installation as required.
- D. Certifications: UL certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. Acoustical performance, products must be tested to the A, D-20, C-20, or C-40 method.
- E. Country of Origin: Submittals must be accompanied by letter, label or certification indicating the manufacturing country of origin. Comply with Made in USA requirements as applicable for the project.
- F. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance as specified in Section 2.2, subcontractor shall be required to send material from every production run appearing on the job, finished as intended to be installed, to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.06 SUSTAINABLE MATERIALS

- A. Transparency: Manufacturers will be given preference when they provide third party verified documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.
- B. Health Product Declaration. The end use product has a published, complete third party verified Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.
- C. Declare Label. The end use product has a published third party verified Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).
- D. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide third party verified emissions data showing their products meet

CDHP Standard Method v1.1 (Section 01350).

- E. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.
- F. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.
- G. Products meeting LEED V4 requirements including:
 - 1. Storage & Collection of Recyclables
 - 2. Construction and Demolition Waste Management Planning
 - 3. Building Life-Cycle Impact Reduction
 - 4. Building Product Disclosure and Optimization Environmental Product Declarations
 - 5. Building Product Disclosure and Optimization Sourcing of Raw Materials
 - 6. Building Product Disclosure and Optimization Material Ingredients
 - 7. Construction and Demolition Waste Management

1.07 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate UL markings.
 - 1. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.
- C. Tectum® Direct-Attached, as with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.
- D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.08 DELIVERY, STORAGE & HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Provide labels indicating brand name, style, size and thickness.
- C. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- D. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.09 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
- B. Do not install ceiling panels until building is closed in and HVAC system is operational.
- C. Locate materials onsite at least 72 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
- D. Maintain the following conditions in areas where acoustical materials are to be installed 72 hours before, during and after installation:
 - 1. Relative Humidity: 25 - 85%.
 - 2. Uniform Temperature: 32 - 120 degrees F (0 - 49 degrees C).

1.10 WARRANTY

- A. Tectum® High NRC Direct-Attached Wall and Ceiling Panels: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
 - 1. Defects in materials or factory workmanship.
- B. Tectum® High NRC Direct-Attached Wall and Ceiling Panels warranty - Thirty (30) years from date of substantial completion.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.11 MAINTENANCE

1.12 EXTRA MATERIALS: DELIVER EXTRA MATERIALS TO OWNER. FURNISH EXTRA MATERIALS DESCRIBED BELOW THAT MATCH PRODUCTS INSTALLED. PACKAGED WITH PROTECTIVE COVERING FOR STORAGE AND IDENTIFIED WITH APPROPRIATE LABELS.

- 1. Tectum® High NRC Direct-Attached Wall and Ceiling Panels: Furnish quality of full-size units equal to 5.0 percent of amount installed.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Tectum® High NRC Direct-Attached Wall or Ceiling Panels:
 - 1. Tectum® by Armstrong World Industries, Inc.

2.02 TECTUM® DIRECT-ATTACHED PANELS

- A. Acoustical Panels Type **TEC**:
 - 1. Surface Texture: Coarse
 - 2. Composition: Aspen wood fibers bonded with inorganic hydraulic cement
 - 3. Finish: Surface appearance shall be consistent from panel to panel
 - 4. Color: Standard Selection: Natural (TNA) or White (TWH)
 - 5. Size: Standard (23 ¾" x 48", 47 ¾" x 48", 23 ¾" x 96", 47 ¾" x 96") (Contractor Option)
 - 6. Thickness: 2"
 - 7. Edge Profile: long edge/short edge – Square
 - 8. UL Classified Noise Reduction Coefficient (NRC): ASTM C 423 ; D-20(0.60) Classified with UL label.
 - 9. UL Classified Flame Spread: ASTM E 1264; Class A. Product must be able to meet this criteria after being painted six times.
 - 10. Light Reflectance (LR) White Panel: ASTM E 1477; (Light Reflectance)
 - 11. Dimensional Stability/Mold Resistance: HumiGuard Plus and no significant mold growth when tested by ASTM D3273.
 - 12. Sustainable: Third party verified EPD (Environmental Product Declaration) and HPD (Health Product Declaration)
 - 13. USDA Certified Biobased Product, 98%
 - 14. Acceptable Product: Tectum® High NRC Direct-Attached

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

PREPARATION

- A. Measure each wall area and establish layout of wall units. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 - 1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

INSTALLATION

- A. Install Tectum® High NRC Direct-Attached Panels in accordance manufacturer's installation instructions.

ADJUSTING AND CLEANING

- A. Replace damaged and broken Tectum® High NRC Direct-Attached Panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any Tectum® High NRC Direct-Attached Ceiling Panels that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION 09 84 00

This page intentionally left blank

SECTION 09 90 00
PAINTING AND COATING - COMMERCIAL FACILITY GUIDE SPECIFICATION - SHERWIN-
WILLIAMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Interior painting and coating systems.
- C. Exterior painting and coating systems.
- D. Scope:
 - 1. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - a. Exterior:
 - 1) Concrete: Cementitious siding, Flexboard, Transite, non-roof shingles, common brick, stucco, tilt-up, precast, and poured-in-place cement.
 - 2) Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
 - 3) Wood: Siding, trim, shutters, sashes, and hardboard-bare/primed.
 - 4) Vinyl siding, EIFS, stucco.
 - b. Interior:
 - 1) Wood: Walls, ceilings, doors, and trim.
 - 2) Drywall: Walls, ceilings, gypsum board, and similar items.
 - 3) Concrete: Floors, non-vehicular.

1.02 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- C. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.
- F. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Product characteristics.
 - 2. Surface preparation instructions and recommendations.
 - 3. Primer requirements and finish specification.
 - 4. Storage and handling requirements and recommendations.
 - 5. Application methods.
 - 6. Clean-up information.
- C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Applicator's qualification statement.
- F. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to manufacturer's label.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.05 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for general requirements for mock-ups.
- B. Provide one accent wall as directed by Architect to demonstrate color and finish.
- C. Provide door and frame assembly indicating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.
- B. Comparable Products: Products of approved manufacturers will be considered in accordance with 01 60 00 - Product Requirements, and the following:
 - 1. Products are approved by manufacturer in writing for application specified.
 - 2. Products that meet or exceed performance and physical characteristics of basis of design products.
 - 3. Other Acceptable Manufacturers:

2.02 PAINTINGS AND COATINGS

- A. General:
 - 1. Provide factory-mixed coatings unless otherwise indicated.
 - 2. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).
 - d. Ozone Transport Commission (OTC) Phase II Model Rule, Architectural and Industrial Maintenance Coatings; www.otcair.org.
 - e. Architectural coatings VOC limits of State in which the project is located.
 - f. USGBC LEED Rating System; www.usgbc.org.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site, or other method acceptable to authorities having jurisdiction.
- C. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Concrete: Cementitious siding, Flexboard, Transite, non-roof shingles, common brick, stucco, tilt-up, precast, and poured-in-place cement.
 - 1. Textured Elastomeric System:
 - a. Textured Finish:
 - 1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer LX02W50: www.sherwin-williams.com/#sle.
(a) 5.3 to 8 mils wet, 2.1 to 3.2 mils dry.
 - 2) 2nd Coat: Sherwin-Williams ConFlex XL Elastomeric High Build Coating, CF11W50: www.sherwin-williams.com/#sle.
(a) 13 to 16 mils wet, 6 to 7.5 mils dry per coat.
 - 3) 3rd Coat: Sherwin-Williams ConFlex XL Textured Elastomeric High Build Coating, CF15W50 Series: www.sherwin-williams.com/#sle.
(a) 20 to 23 mils wet, 9.4 to 11 mils dry per coat.
- B. Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
 - 1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
(a) 5 to 10 mils wet, 1.8 to 3.6 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
(a) 2 to 4 mils dry per coat.
 - 2. Alkyd Systems, Water Based:
 - a. Semi-Gloss Finish:

- 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
(a) 5 mils wet, 2 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.
(a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.
- C. Wood: Siding, trim, shutters, sashes, and hardboard-bare/primed.
1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Latex Wood Primer, B42W8041: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.4 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
(a) 2 to 4 mils dry per coat.
- D. Vinyl Siding, EIFS, Stucco:
1. Latex Systems:
 - a. Satin Finish:
 - 1) 1st and 2nd Coat: Sherwin-Williams A-100 Exterior Latex Satin, A82 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.

2.04 PAINT SYSTEMS - INTERIOR

- A. Wood: Walls, ceilings, doors, and trim.
1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Premium Wall and Wood Primer, B28W8111: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.8 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProClassic Waterborne Acrylic Semi-Gloss, B31 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.3 mils dry per coat.
 2. Alkyd Systems, Water Based:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Premium Wall and Wood Primer, B28W8111: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.8 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.
(a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.
- B. Drywall: Walls, ceilings, gypsum board, and similar items.
1. Latex Systems:
 - a. Eg-Shel Finish High Performance (HP):
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 HP Zero VOC Eg-Shel, B20-1950 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.7 mils dry per coat.

2. Epoxy Systems, Water Based:
 - a. Eg-Shel/Low Luster Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45 Series: www.sherwin-williams.com/#sle.
(a) 4 mils wet, 1.5 mils dry per coat.
- C. Concrete: Floors, non-vehicular.
 1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st and 2nd Coat: Sherwin-Williams Tread-Plex Acrylic Floor Coating, B90 Series: www.sherwin-williams.com/#sle.
(a) 3.5 mils wet, 1.5 mils dry per coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.
- D. Concrete:
 1. Remove release agents, curing compounds, efflorescence, and chalk.
- E. Masonry: Remove efflorescence and chalk.
- F. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.
- G. Plaster: Fill hairline cracks, small holes, and imperfections with patching plaster. Make smooth and flush with adjacent surfaces. Treat textured, soft, porous, or powdery surfaces in accordance with manufacturer's instructions.
- H. Concrete Floors and Traffic Surfaces: Prepare concrete in accordance with SSPC-SP 13/NACE No.6.
- I. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Remove rust, loose mill scale, and other foreign substances using methods recommended by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.
- J. Wood: Remove dust, grit, and foreign matter. Scrape, sand, and spot prime knots and pitch streaks. Fill nail holes and imperfections with wood filler and sand smooth.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.
- D. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

3.04 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to top coat manufacturers.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 90 00

**SECTION 10 14 19
DIMENSIONAL LETTER SIGNAGE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dimensional letter signage.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
- D. Selection Samples: Where materials, colors, and finishes are not specified, submit two sets of selection charts or chips.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- F. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package dimensional letter signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Dimensional Letter Signs:
 - 1. Corpus Christi Stampworks.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 DIMENSIONAL LETTERS

- A. Applications: Building identification.
 - 1. Use individual metal letters.

2. Mounting Location: Exterior as indicated on drawings.
- B. Metal Letters:
 1. Material: Fabricated Aluminum.
 2. Thickness: 1-1/2" inch minimum.
 3. Letter Height: As indicated on drawings.
 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 5. Finish: Brushed, satin.
 6. Color: As selected.
 7. Mounting: Concealed screws.

2.04 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION 10 14 19

**SECTION 10 14 23
PANEL SIGNAGE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Panel signage.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
 - 2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - c. Submit for approval by Owner through Architect prior to fabrication.
- D. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- F. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.
- C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Panel Signage:
 - 1. Corpus Christi Stampworks. Basis of Design: Visitouch DuraDot ADA sign systems.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

- A. Panel Signage:
 - 1. Application: Room and door signs.
 - 2. Description: Flat signs with engraved panel media, tactile characters.
 - 3. Sign Size: As indicated on drawings.
 - 4. Total Thickness: 1/8 inch.
 - 5. Sign Edges: Squared.
 - 6. Corners: Radiused.
 - 7. Color and Font, unless otherwise indicated:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 - c. Background Color: as selected by Architect from manufacturer's full range.
 - d. Character Color: as selected by Architect from manufacturer's full range color.
 - 8. Material: Laminated colored plastic engraved through face to expose core as background color.
 - 9. Material: Acrylic plastic base with applied plastic letters and braille.
 - 10. Profile: Flat panel without frame.
 - 11. Tactile Letters: Raised 1/32 inch minimum.
 - 12. Braille: Grade II, ADA-compliant.
 - 13. One-Sided Wall Mounting: Tape adhesive and silicone.

2.04 ACCESSORIES

- A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION 10 14 23

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES - ASI

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Custodial accessories.
- B. Feminine hygiene vendors and disposals.
- C. Grab bars.
- D. Hand dryers.
- E. Mirrors.
- F. Paper towel combination units.
- G. Soap and hand sanitizer dispensers.
- H. Toilet tissue dispensers.

1.02 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer: American Specialties, Inc: www.americanspecialties.com/#sle.
- B. Substitutions: See Section 01 60 00 - Product Requirements.
 - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect minimum of 10 working days prior to bid date and must be made available to all bidders. Proposed substitutes must be accompanied by review of specification and ASI Technical Data Sheets noting compliance on line-by-line basis.
 - 2. Products other than basis of design are subject to compliance with specified requirements and prior approval of Architect. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

2.02 CUSTODIAL ACCESSORIES

- A. Mop and Broom Holder: 0.0375 inch thick stainless steel, Type 304, hat-shaped channel.
 - 1. Mounting: As indicated in product listing.
 - 2. Holders: Cadmium-plated steel with spring-loaded rubber cam holders.
 - 3. Hooks: 14 gauge, 0.078 inch thick stainless steel rag hooks.
 - 4. Length: Manufacturer's standard length for number of holders.
 - 5. Products:
 - a. Model 8215-4 - 4 Holders - Mop Rack - Surface-mounted.
 - b. Substitutions: 01 60 00 - Product Requirements.

2.03 FEMININE HYGIENE VENDORS AND DISPOSALS

- A. Sanitary Napkin Disposal Unit: Stainless steel, self-closing door, locking bottom panel with full-length heavy-duty stainless steel multi-staked piano hinge, removable receptacle.
 - 1. Mounting: As indicated in product listing.
 - 2. Cabinet and Door: Fully welded, 22 gauge, 0.03 inch thick sheet.
 - 3. Products:
 - a. Model 0852 - Satin Stainless Steel Finish - Sanitary Napkin Disposal -SH - with Shelf - Surface-mounted.

- b. Substitutions: Section 01 60 00 - Product Requirements.

2.04 GRAB BARS

- A. Grab Bars: Type 304 stainless steel.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 lbf, minimum.
 - b. OD: As indicated in product listing.
 - c. Tubing Thickness: As indicated on Technical Data Sheet for selected ASI model.
 - d. Flange Mounting: As indicated in product listing.
 - e. Flange Thickness: 11 gauge, 0.125 inch
 - f. Clearance: 1-1/2 inch clearance between wall and inside of grab bar.
 - g. Finish: As indicated in product listing.
 - h. Length and Configuration: As indicated in product listing.
 - i. Products:
 - 1) Model 3801-48 - 48 inch length - Snap Flange, 1-1/2 inch OD, Smooth - Straight Grab Bar.
 - 2) Model 3801-36 - 36 inch length - Snap Flange, 1-1/2 inch OD, Smooth - Straight Grab Bar.

2.05 HAND DRYERS

- A. Electric Hand Dryers: Traditional fan-in-case type.
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Mounting: As indicated in product listing.
 - 3. Cover: As indicated in product listing.
 - a. Color: As indicated in product listing.
 - b. Tamper-resistant screw attachment of cover to mounting plate.
 - 4. Warranty: 5 years.
 - 5. Products:
 - a. Model 0199-00 - White Porcelain Enamel Steel - Turbo ADA - Automatic High Speed Hand Dryer - ADA Compliant - (115-120V) - Surface-mounted.
 - b. Substitutions: Section 01 60 00 - Product Requirements.

2.06 MIRRORS

- A. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass, ASTM C1036.
 - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - 2. Size: 18 inches wide by 36 high..
 - 3. Channel Frame: One piece roll formed 20 gauge, 0.0375 inch, 1/2 inch by 1/2 inch Type 304 stainless steel channel that encases mirror and backing with tight mitered corners, and tamperproof hanging system; satin finish.
 - 4. Products:
 - a. Model 0620 Series - Stainless Steel Chan-Lok Frame - Plate Glass Mirror- Channel Frame.

2.07 PAPER TOWEL COMBINATION UNITS

- A. Combination Towel Dispenser/Waste Receptacle: Stainless steel; seamless wall flanges, continuous heavy-duty stainless steel multi-staked piano hinges, tumbler locks on upper and lower doors.
 - 1. Mounting: As indicated in product listing.
 - 2. Stainless Steel Thickness: As indicated on Technical Data Sheet for selected ASI model.
 - 3. Waste Receptacle Liner: Reusable, heavy-duty vinyl.
 - 4. Towel Type: As indicated in product listing.

5. Folded Towel Dispenser Capacity: As indicated in product listing.
6. Waste Receptacle Capacity: As indicated in product listing.
7. Products:
 - a. Model 04692-6 - Semi-recessed - Traditional Collection - Paper Towel Dispenser and Waste Receptacle - Roll - 18 gal.

2.08 SOAP AND HAND SANITIZER DISPENSERS

- A. Soap Dispenser: Liquid soap dispenser, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
 1. Mounting: As indicated in product listing.
 2. Minimum Capacity: As indicated in product listing.
 3. Products:
 - a. Model 0347 - Satin Stainless Steel Finish - Soap Dispenser - Liquid, Vertical Valve - 40 oz - Surface-mounted.

2.09 TOILET TISSUE DISPENSERS

- A. Toilet Tissue Dispenser: Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, semi-recessed, stainless steel unit with pivot hinge, tumbler lock.
 1. Products:
 - a. Model 0030 - Surface-mounted - Toilet Tissue Dispenser - Twin Hide-A-Roll.

2.10 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

2.11 FINISHES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00

This page intentionally left blank

**SECTION 10 44 00
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pound.
 - 3. Size and classification as scheduled.
 - 4. Finish: Baked polyester powder coat, red color.
 - 5. Temperature range: Minus 40 degrees F to ____ degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

- B. Cabinet Construction: Non-fire rated.
 - 1. Formed primed steel sheet; 0.036 inch thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
- D. Cabinet Configuration: Semi-recessed type.
 - 1. Size to accommodate accessories.
 - 2. Trim: Flat rolled edge, with 3 inch wide face.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
- F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

3.03 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 10 44 00

**SECTION 12 21 13
HORIZONTAL LOUVER BLINDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

- A. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the placement of concealed blocking to support blinds. See Section 06 10 00.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 6 inch long illustrating slat materials and finish, cord type and color.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Blind Assemblies: One of each size.
 - 3. Extra Slats: 20 of each type and size.
 - 4. Extra Lift Cords, Control Cords, and Wands: One of each type.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Horizontal Louver Blinds:
 - 1. Levolor; Faux Wood Blinds: www.commercial.levolor.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BLINDS WITHOUT SIDE GUIDES

- A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
- B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
- C. Metal Slats: Spring tempered pre-finished _____; square slat corners, with manufacturing burrs removed.
 - 1. Width: 2 inch.
 - 2. Color: As selected by Architect.
- D. Slat Support: Woven polypropylene cord, ladder configuration.

- E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
- F. Headrail Attachment: Wall brackets.
- G. Accessory Hardware: Type recommended by blind manufacturer.

2.03 FABRICATION

- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1-1/2 inch.
- C. At openings requiring multiple blind units, provide separate blind assemblies with space of 1-1/2 inch between blinds, located at window mullion centers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed. See Section 06 10 00.

3.02 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.

3.03 TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
- B. Maximum Offset From Level: 1/8 inch.

3.04 ADJUSTING

- A. Adjust blinds for smooth operation.
- B. Motorized Blinds:
 - 1. Set limit switches for uniform range of motion according to project requirements.
 - 2. Program control system parameters according to requirements of Owner.

3.05 CLEANING

- A. Clean blind surfaces just prior to occupancy.

END OF SECTION 12 21 13

10/25/2024

DIVISION 22 – PLUMBING

22 00 00	SUMMARY OF PLUMBING WORK
22 05 00	COMMON WORK RESULTS FOR PLUMBING
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 07 19	PLUMBING PIPING INSULATION
22 11 16	DOMESTIC WATER PIPING
22 11 19	DOMESTIC WATER PIPING SPECIALTIES
22 13 13	FACILITY SANITARY SEWERS
22 13 19	SANITARY WASTE PIPING SPECIALTIES
22 33 00	ELECTRIC DOMESTIC WATER HEATERS
22 42 00	COMMERCIAL PLUMBING FIXTURES
22 47 13	DRINKING FOUNTAINS



DIVISION 23 – HEATING VENTILATION & AIRCONDITIONING

23 00 00	HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 63	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 13	DUCT INSULATION
23 09 23	DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
23 23 00	REFRIGERANT PIPING
23 26 00	CONDENSATE DRAIN PIPING
23 31 13	METAL DUCTS
23 33 00	HVAC DUCT ACCESSORIES
23 33 46	FLEXIBLE DUCTS
23 34 16	CENTRIFUGAL HVAC FANS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 73 12	DX AIR-HANDLING UNITS, SINGLE ZONE VAV



DIVISION 26/27/28 – ELECTRICAL

26 00 00	ELECTRICAL
26 00 01	ELECTRICAL GENERAL REQUIREMENTS
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL
26 05 19	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS



3533 Moreland Dr. Suite A | Weslaco, Texas 78596
P: 956.973.0500 | F:956.351.5750
www.trinitymep.com | Copyright 2024
Texas Registered Engineering Firm No. - F10362

26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 73.13	SHORT CIRCUIT STUDIES
26 05 73.19	ARC-FLASH HAZARD ANALYSIS
26 09 23	LIGHTING CONTROL SYSTEM
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16.16	ENCLOSED SWITCHES
26 43 13	SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
26 51 00	INTERIOR LIGHTING
26 56 00	EXTERIOR LIGHTING
27 05 33	CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

SECTION 22 00 00

SUMMARY OF PLUMBING WORK

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. Plumbing Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC
3533 Moreland Dr. Ste. A
Weslaco, Texas 78596
Phone Number: (956) 973-0500
Contact Person: Leonardo Munoz, P.E.

C. General Scope of Work:

- 1. Install systems and equipment as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect all water, sewer, and/or power to fixtures.
- 2. Provide all materials and labor associated with a complete operational installation of new systems including, but not limited to:
 - Fixtures for facility
 - Piping for Sanitary Sewer and Vent Systems
 - Piping for Domestic water and Hot Water Systems.

1.2 COORDINATION

- A. All plumbing work shall be done under sub-contract to a General Contractor. Plumbing Contractor shall coordinate all work through General Contractor, even in areas where only plumbing work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- E. Fully coordinate with electrical contractor for providing power to plumbing equipment.

1.3 UTILITIES

- 1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
- 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.4 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
 - 3. Temporary fencing around equipment while site work is in progress.

1.5 SUBMITTALS

- 1. All equipment and fixtures shall be provided with a submittal.
- 2. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire plumbing or in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Common requirements and procedures for plumbing systems.
2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
3. Furnish and install sealants relating to installation of systems installed under this Division.
4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:

1. Sleeves, inserts, supports, and equipment for plumbing systems installed under other Sections.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's catalog data for each manufactured item.

- 1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
- 2) Include name, address, and phone number of each supplier.

B. Informational Submittals:

1. Qualification Statement:

a. Plumbing Subcontractor:

- 1) Provide Qualification documentation if requested by Architect or Owner.

b. Installer:

- 1) Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):

- 1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:

a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.

b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:

- (1) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.

- (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
- c) Provide operating instructions to include:
 - (1) General description of fire protection system.
 - (2) Step by step procedure to follow for shutting down system or putting system into operation.
- b. Warranty Documentation:
 - 1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 - 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
 - 3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.
- B. Qualifications.
 - 1. Plumbing Subcontractor:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in plumbing installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
 - 2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Accept valves on site in shipping containers with labeling in place.
 - 2. Provide temporary protective coating on cast iron and steel valves.
 - 3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Storage And Handling Requirements:
 - 1. In addition to requirements specified within, stored material shall be readily accessible for inspection by Architect/engineer until installed.
 - 2. Store items subject to moisture damage in dry, heated spaces.

1.5 WARRANTY

- A. Manufacturer Warranty:

1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.
- B. Special Warranty:
 1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
 2. If plumbing sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local plumbing sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
- B. Pipe And Pipe Fittings:
 1. Weld-O-Let and Screw-O-Let fittings are acceptable.
 2. Use domestic made pipe and pipe fittings on Project, except non-domestic made cast iron pipe and fittings by MATCO-NORCA are acceptable.
- C. Sleeves:
 1. General:
 - a. Two sizes larger than bare pipe or insulation on insulated pipe.
 2. In Concrete And Masonry:
 - a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
 3. In Framing And Suspended Floor Slabs:
 - a. Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal.
- D. Valves:
 1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers:

3.2 Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.3 EXAMINATION

- A. Drawings:
 1. Plumbing Drawings show general arrangement of piping, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing Drawings.
 3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- B. Verification Of Conditions:

1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which plumbing work is dependent for efficiency and report work that requires correction.
 2. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
 3. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
- 3.4 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- 3.5 PREPARATION
- A. Demolition Requirements:
 - B. Changes Due To Equipment Selection:
 1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings showing proposed installations.
 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 3. Provide additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
 4. Be responsible for proper location of rough-in and connections provided under other Divisions.
- 3.6 INSTALLATION
- A. Interface With Other Work:
 1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
 2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.
 3. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
 - B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.
 - C. Locating Equipment:
 1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
 2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
 3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.

4. Determine exact route and location of each pipe before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
 - 2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
 - b. Offsets, Transitions, and Changes in Direction:
 - 1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - 2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.
- D. Penetration Firestops:
 1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.
- E. Sealants:
 1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
 2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.
- F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
 1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe **3/4 inch (19 mm)** in diameter and smaller.
 - d. Install piping systems so they may be easily drained
 - e. Install piping to insure noiseless circulation.
 - f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 3. Do not install piping in shear walls.
 4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
 5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 6. Make changes in direction with proper fittings.
 7. Expansion of Thermoplastic Pipe:

- a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.

G. Sleeves:

1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade (unless noted on plans).
2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer's recommendations for PEX pipe (if used) penetrations through studs and floor slabs.
3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
4. Sleeves through floors and foundation walls shall be watertight.

H. Escutcheons:

1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

3.7 REPAIR / RESTORATION

- A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it:
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 2. Surface finishes shall exactly match existing finishes of same materials.

3.8 FIELD QUALITY CONTROL

A. Field Tests:

1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:

1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
2. Repeat tests on new material, if requested.

3.9 CLEANING

A. Remove dirt, grease, and other foreign matter from each length of piping before installation:

1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

3.10 CLOSEOUT ACTIVITIES

A. Instruction of Owner:

1. Instruct building maintenance personnel in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.

2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.11 PROTECTION

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common hanger and support requirements and procedures for plumbing systems.
- B. Products Installed But Not Furnished Under This Section:
 - 1. Paint identification for gas piping used in HVAC equipment.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Anvil International,
 - b. Cooper B-Line,
 - c. Unistrut, Wayne,
- B. Materials:
 - 1. Hangers, Rods, And Inserts
 - a. Galvanized and UL approved for service intended.
 - b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
 - 1) Support insulated pipes **2 inches** in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
 - 2) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger: Anvil Fig. 69.
 - (2) Insulation Protection Shield: Anvil Fig. 167.
 - (3) Equals by Cooper B-Line.
 - 3) Support insulated pipes **2-1/2 inches** in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger: Anvil Fig. 260.
 - (2) Roller Assembly: Anvil Fig. 171.
 - (3) Insulation Protection Shield: Anvil Fig. 167.
 - (4) Equals by Cooper B-Line.
 - 4) Support uninsulated copper pipe **2 inches** in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
 - a) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
 - (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.

- (3) Equals by Cooper B-Line.
- 5) Support uninsulated copper pipe **2-1/2 inches** in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
 - (2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
 - (3) Equals by Cooper B-Line.

c. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
Number	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

- 1) Size trapeze angles so bending stress is less than **10,000 psi**
- e. Riser Clamps For Vertical Piping:
 - 1) Type Two Acceptable Products:
 - a) Anvil Fig. 261.
 - b) Equals by Cooper B-Line.
- f. Concrete Inserts:
 - 1) Individual Inserts:
 - a) Suitable for special nuts size **3/8 inch** through **7/8 inch** with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
 - b) Type Two Acceptable Products:
 - (1) Anvil Fig. 282.
 - (2) Equals by Cooper B-Line.
 - 2) Continuous Inserts:

- a) Class Two Quality Standard: Equal to Unistrut P-3200 series.
- g. Steel Deck Bracket:
 - 1) Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work: If project contains concrete structural system.
 - 1. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
- B. Piping:
 - 1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:
 - 1) Support metal piping at 96 inches on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - 2) Support thermoplastic pipe at 48 inches on center maximum.
 - 3) Support PEX pipe at 32 inches minimum on center.
 - 4) Provide support at each elbow. Install additional support as required.
 - c. Supports for Vertical Piping:
 - 1) Place riser clamps at each floor or ceiling level.
 - 2) Securely support clamps by structural members, which in turn are supported directly from building structure.
 - 3) Provide clamps as necessary to brace pipe to wall.
 - d. If Structural concrete systems are used: Install supports from inserts cast into concrete floor system, including concrete joists and floor slabs. Where inserts cannot be used, provide expansion shields and support hangers from angles held in place by expansion bolts, never directly from expansion bolt itself. Provide calculations necessary to determine number of expansion bolts required to equal capacity of cast-in-place insert.
 - e. Attach Unistrut to structural steel roof supporting structure. Spacing and support as described above.
 - f. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
 - 2. Gas piping Identification:
 - a. Apply paint identification for gas piping used with HVAC equipment as specified in Section 23 0553.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:

1. Labels:

a. Equipment Identification:

- 1) Black formica, with white reveal when engraved.
- 2) Lettering to be 3/16 inch high minimum.

2. Paint:

a. One Coat Primer:

- 1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
- 2) 6-205 Metal Primer under dark color paint.
- 3) 6-6 Metal Primer under light color paint.

b. Finish Coats: Two coats 53 Line Acrylic Enamel.

c. Type Two Acceptable Products.

- 1) Paint of equal quality from following Manufacturers may be submitted for Architect's approval before use. Maintain specified colors, shades, and contrasts.

- a) Benjamin Moore,
- b) ICI Dulux,
- c) Sherwin Williams,

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:

1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
2. Water Heaters.
3. Engrave following data from Equipment Schedules on Drawings onto labels:
 - a. Equipment mark.
 - b. Room(s) served.
 - c. Panel and breaker from which unit is powered.

B. Painting:

1. Only painted legends, directional arrows, and color bands are acceptable.
2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
 - a. Adjacent to each item of equipment.
 - b. At point of entry and exit where piping goes through wall.

- c. On each riser and junction.
- d. Every **25 feet** on long continuous lines.
- e. Stenciled symbols shall be one inch high and black.

3.2 ATTACHMENTS

A. Schedules:

1. Pipe Identification Schedule:

- a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation
Domestic Cold Water	CW
Domestic Hot Water	HW

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART1- GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install insulation on hot and cold water lines, fittings, valves, and accessories as described in Contract Documents.
 - 2. Furnish and install insulation on roof drain piping as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 1116: 'Domestic Water Piping'.
 - 2. Section 22 1400: 'Facility Storm Drainage'.(if provided on plans)

1.2 SUBMITTALS

- A. Informational Submittals:
 - 1. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

Service Water Temperature	Pipe Sizes		
	Up to 1-1/4 In	1-1/2 to 2 In	Over 2 In
170 - 180 Deg F	One In	1-1/2 In	2 In
140 - 160 Deg F	1/2 In	One In	1-1/2 In
45 - 130 Deg F	1/2 In	1/2 In	One In

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:

1. Manufacturer Contact List:

- a. Armacell, Mebane, NC www.armacell.com.
- b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
- c. IMCOA, Youngsville, NC www.nomacokflex.com.
- d. Johns-Manville, Denver, CO www.jm.com.
- e. Knauf, Shelbyville, IN www.knauffiberglass.com.
- f. Manson, Brossard, PQ, Canada www.isolationmanson.com.
- g. Nomaco Inc, Yopungsville, NC www.nomacokflex.com.
- h. Owens-Corning, Toledo, OH www.owenscorning.com.
- i. Speedline Corp, Solon, OH www.speedlinepvc.com.
- j. CertainTeed Manson.
- k. Knauf FiberGlass GmbH.
- l. Owens-Corning Fiberglas Corp.
- m. Schuller International, Inc.
- n. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- o. Armstrong World Industries, Inc.
- p. Rubatex Corp.

B. Materials:

1. Above Grade Metal Piping:

a. Insulation For Piping:

- 1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.
- 2) Insulation Thickness:
- 3) Performance Standards: Fiberglas ASJ by Owens-Corning.
- 4) Type One Acceptable Manufacturers:
 - a) Childers Products.
 - b) Knauf.
 - c) Manson.
 - d) Owens-Corning.
 - e) Johns-Manville.
 - f) Equal as approved by Architect before bidding. See Section 01 6200.

b. Fitting, Valve, And Accessory Covers:

- 1) PVC.
- 2) Performance Standard: Zeston by Johns-Manville.
- 3) Type One Acceptable Manufacturers:

- a) Knauf.
 - b) Speedline.
 - c) Johns-Manville.
 - d) Equal as approved by Architect before bidding. See Section 01 6200.
- 2. Below Grade Metal Piping:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
- 3. Pex Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit
 - b) by Armacell.
 - c) ImcoLock by Imcoa.
 - d) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
 - c)
- 4. PP-R Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
- 5. PVC or ABS Piping, Above And Below Grade - Facility Storm Drain:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.

- b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
- b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Above Grade Piping:
 - 1. Apply insulation to clean, dry piping with joints tightly butted.
 - 2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
 - 3. Piping up to **1-1/4 inch** Diameter:
 - a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
 - b. Adhere **3 inch** wide self-sealing butt joint strips over end joints.
 - 4. Piping **1-1/2 inches** Diameter And Larger:
 - a. Use broken-joint construction in application of two-layer covering.
 - b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
 - 1) Apply by hand in several layers to make up total specified thickness.
 - 2) Final layer shall have smooth uniform finish before application of covering.
 - 5. Fittings, Valves, And Accessories:
 - a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
 - b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
 - c. Piping Up To **1-1/4 Inch** Diameter:
 - 1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
 - 2) Alternate Method:
 - a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two **1/8 inch** wet coats of vapor barrier mastic reinforced with glass fabric extending **2 inches** onto adjacent insulation.
 - d. Piping **1-1/2 inches** To **2 Inches** :
 - 1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
 - 2) Apply final coat of fitting mastic over insulating cement.
 - e. Piping **2-1/2 inch** And Larger:
 - 1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
 - 2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
 - 6. Pipe Hangers:
 - a. Do not allow pipes to come in contact with hangers.

b. Pipe Shield:

- 1) Provide schedule 40 PVC by 6 inch long at each clevis and/or unistrut type hanger.
- 2) Provide 16 ga by 6 inch long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
- 3) Provide 22 ga by 6 inch long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.

c. At Pipe Hangers:

- 1) Provide rigid calcium silicate insulation (100 psi compressive strength) at least 2 inches beyond shield.
7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

B. Below Grade Piping:

1. Slip underground pipe insulation onto pipe and seal butt joints.
2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.

3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.4 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry during application and finishing.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the least number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.

2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- N. Apply insulation with integral jackets as follows:
 1. Pull jacket tight and smooth.
 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 1. Firestopping and fire-resistive joint sealers are specified in Section "Firestopping."

3.5 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.

3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

3.6 Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

B. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.

C. Apply insulation to valves and specialties as follows:

1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.7 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same thickness as pipe insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 2. When premolded sections of insulation are not available, apply mitered sections of phenolic-foam insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded sections of insulation are not available, apply mitered sections of phenolic-foam insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without distributing insulation.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.8 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.9 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
 1. Draw jacket material smooth and tight.
 2. Apply lap or joint strips with the same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.
- C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Flexible connectors.
 2. Fire-suppression piping.
 3. Drainage piping located in crawl spaces, unless otherwise indicated.
 4. Below-grade piping, unless otherwise indicated.
 5. Chrome-plated pipes and fittings, unless potential for personnel injury.
 6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water piping.
 1. Operating Temperature: 60 to 80 deg F
 2. Insulation Material: Mineral Fiber
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: Yes.

- 6. Finish: None.
- B. Service: Domestic hot and recirculated hot water.
 - 1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 - 2. Insulation Material: Mineral fiber
 - 3. Insulation Thickness: 1" thick
 - 4. Field-Applied Jacket: Foil and Paper(ASJ)
 - 5. Vapor Retarder Required: No
 - 6. Finish: None.
- C. Service: Condensate and equipment drain piping.
 - 1. Operating Temperature: 40 to 60 deg F
 - 2. Insulation Material: Flexible elastomeric, only on first ten feet of pipe from trap.
 - 3. Insulation Thickness: 3/4"
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No.
 - 6. Finish: Two coats of the insulation manufacturer's recommended protective coating.
- D. Service: Refrigerant suction and hot-gas piping.
 - 1. Operating Temperature: 35 to 50 deg F
 - 2. Insulation Material: Flexible elastomeric.
 - 3. Insulation Thickness: 1" thick.
 - 4. Field-Applied Jacket: Aluminum Jacket on building exterior application only.
 - 5. Vapor Retarder Required: Yes.
 - 6. Finish: None.
- E. Service: For obtaining fire/smoke rating in return air plenum (calbes, PE, PB, PP, ABS, PVC, CPVC, etc).
 - 1. Operating Temperature: 35 to 90 deg F
 - 2. Insulation Material: 3M Fire Barrier Plenum Wrap 5 A or equal.
 - 3. Insulation Thickness: larger of 1" or mfr's recommendations.
 - 4. Field-Applied Jacket: scrim reinforced foil
 - 5. Vapor Retarder Required: None.
 - 6. Finish: None.

3.12 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water.
 - 1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 - 2. Insulation Material: Mineral fiber.
 - 3. Insulation Thickness: Apply the following insulation thicknesses: 1"
 - 4. Field-Applied Jacket: Aluminum.
 - 5. Vapor Retarder Required: Yes.
 - 6. Finish: None.
- B. Service: Refrigerant suction.
 - 1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
 - 2. Insulation Material: Flexible elastomeric.
 - 3. Insulation Thickness: Apply the following insulation thicknesses: 1/2"
 - 4. Field-Applied Jacket: Aluminum

5. Vapor Retarder Required: Yes.
6. Finish: None.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- B. Includes But Not Limited To:
 - 1. Perform excavating and backfilling required by work of this Section.
 - 2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines **5 feet** from building perimeter as described in Contract Documents.

1.2 PERFORMANCE REQUIREMENTS

- B. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Distribution Piping: 125 psig..

1.3 SUBMITTALS

- B. Action Submittals:
 - 1. Product Data: For pipe, tube, fittings, and couplings.
 - 2. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Informational Submittals:
 - 1. Test And Evaluation Reports:
 - b. Written report of sterilization test.
- D. Shop Drawings:
 - b. Piping Layout:
 - 1) Provide as-built drawings at end of project.

1.4 QUALITY ASSURANCE

- B. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- D. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components.
- E. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:

1. Manufacturer Contact List:

- b. Aquatherm, Inc.,
- c. Cash Acme,
- d. Cla-Val Company,
- e. Conbraco Industries Inc,
- f. Hammond Valve,
- g. Handy & Harmon Products Div,
- h. Honeywell Inc,
- i. Leonard Valve Co,
- j. Milwaukee Valve Co,
- k. Nibco Inc,
- l. Rehau,
- m. Sloan Valve Co,
- n. Spence Engineering Co,
- o. Symmons Industries, Braintree,
- p. Uponor Inc,
- q. Viega ProPress, Wic
- r. Watts Regulator Co,
- s. Wilkins (Zurn Wilkins),
- t. Zurn PEX, Inc.

B. Materials:

1. Design Criteria:

- b. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
- c. No CPVC allowed.

2. Pipe:

b. Copper:

3) Above-Grade:

- a) Meet requirements of ASTM B88, Type K & L.
- b) Hard Copper Tube: ASTM B 88, Types K and L, water tube, drawn tempered.
- c) Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

- d) Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - e) Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
 - f) Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - g) Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- 4) Below-Grade:
 - a) Meet requirements of ASTM B88, Type K. **3/4 inch** minimum under slabs.
 - b) **2 inches** And Smaller: Annealed soft drawn.
 - c) **2-1/2 inches** And Larger: Hard Drawn.
- 5) Fittings:
 - a) For Copper Pipe: Wrought copper.
- 3. Connections For Copper Pipe:
 - b. Above-Grade:
 - 3) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
 - 4) Viega ProPress System
 - c. Below Grade:
 - 3) Brazed using following type rods:
 - a) Copper to Copper Connections:
 - 2) AWS Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - 3) AWS Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 4) Copper to Brass or Copper to Steel Connections: AWS Classification BAg-5 Silver (45 percent silver).
 - 5) Do not use rods containing Cadmium.
 - 6) Brazing Flux:
 - a) Approved Products:
 - 1) Stay-Silv white brazing flux by Harris Product Group.
 - 2) High quality silver solder flux by Handy & Harmon.
 - 7) Joints under slabs acceptable only if allowed by local codes.
- 4. Ball Valves:
 - b. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
 - c. Valves shall be two-piece, full port for **150 psi** SWP.
 - 3) Operate with flow in either direction, suitable for throttling and tight shut-off.
 - 4) Body: Bronze, **150 psig** wsp at **350 deg F** and **400 psig** wog.
 - 5) Seat: Bubble tight at **100 psig** under water.
 - d. Class One Quality Standard: Nibco T585 or S585.
 - 3) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.

5. Combination Pressure Reducing Valve / Strainer:
 - b. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
 - c. Built-in thermal expansion bypass check valve.
 - d. Class One Quality Standard: Watts LFU5B:
 - 3) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Below Grade:
 1. Install piping under slabs without joints where possible.
 2. Insulate water piping buried within building perimeter.
 3. Bury water piping **6 inches** minimum below bottom of slab and encase in **2 inches** minimum of sand.
- B. Locate cold water lines a minimum of **6 inches** from hot water line.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Before pipes are covered, test systems in presence of Architect/Engineer at **125 psig** hydrostatic pressure for four (4) hours and show no leaks.
 2. Disconnect equipment not suitable for **125 psig** pressure from piping system during test period.

3.3 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 2. Adjust calibrated balancing valves to flows indicated.

3.4 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - b. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - c. Fill and isolate system according to either of the following:
 - 3) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

- 4) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - d. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- D. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Balancing valves.
 - 2. Washer-supply outlets.
 - 3. Key-operation hydrants.
 - 4. Trap seal primer valves.
 - 5. Drain valves.
 - 6. Miscellaneous piping specialties.
 - 7. Sleeve penetration systems.
 - 8. Flashing materials.

1.2 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

PART 2 - PRODUCTS

2.1 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Manufacturers:
 - 1. Armstrong Pumps, Inc.
 - 2. Flow Design, Inc.
 - 3. ITT Industries; Bell & Gossett Div.
 - 4. Taco, Inc.
 - 5. Watts Industries, Inc.; Water Products Div.
 - 6. 2" and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 - 7. 2" and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
 - 8. 2.5" and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- C. B. Memory-Stop Balancing Valves, NPS 2 (DN 50) and smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.
- D. Manufacturers:

1. Conbraco Industries, Inc.
2. Crane Co., Crane Valve Group; Crane Valves.
3. Grinnell Corporation.
4. NIBCO INC.
5. Red-White Valve Corp.

2.2 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
 1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.

2.3 OUTLET BOXES

- A. Manufacturers:
 1. Acorn Engineering Company.
 2. Gray, Guy Manufacturing Co., Inc.
 3. Symmons Industries, Inc.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- C. Clothes Washer Outlet Boxes: With hot- and cold-water hose connections, drain, and the following:
 1. Box and Faceplate: [Stainless steel] [Enameled or epoxy-painted steel].
 2. Shutoff Fitting: Two hose bibbs.
 3. Supply Fittings: Two NPS 1/2 (DN 15) gate, globe, or ball valves and NPS 1/2 (DN 15) copper, water tubing.
 4. Drain: NPS 2 (DN 50) standpipe, P-trap, and direct waste connection to drainage piping.
 5. Inlet Hoses: Two ASTM D 3571, 60-inch- (1500-mm-) long, rubber household clothes washer inlet hoses with female hose-thread couplings.
 6. Drain Hose: One 48-inch- (1200-mm-) long, rubber household clothes washer drain hose with hooked end.
- D. Ice-maker Outlet Boxes: With hose connection and the following:
 1. Box and Faceplate: Stainless steel.
 2. Shutoff Fitting: Hose bibb.
 3. Supply Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

2.4 KEY-OPERATION HYDRANTS

- A. Manufacturers:
 1. Josam Co.
 2. Smith, Jay R. Mfg. Co.
 3. Woodford Manufacturing Co.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
 1. Inlet: 3/4 " or NPS 1" threaded or solder joint.
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. Operating Keys: One with each key-operation hydrant.

- C. Moderate-Climate, Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, and concealed outlet.
 - 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
- D. Hot and Cold, Nonfreeze Concealed-Outlet Wall Hydrants: With deep flush-mounting box with cover; hot- and cold-water casings and operating rods to match wall thickness; concealed outlet; wall clamps; and factory- or field-installed, nonremovable and manual drain-type, hose-connection vacuum breaker complying with ASSE 1011.

2.5 ROOF HYDRANTS

- A. Design Criteria:
 - 1. Provide dual check backflow preventer.
 - 2. Non-freeze.
 - 3. Drain port - connect to drain

2.6 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
- B. Manufacturers:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Precision Plumbing Products, Inc.
 - 4. Smith, Jay R. Mfg. Co.
 - 5. 125-psig (860-kPa) minimum working pressure.
 - 6. Bronze body with atmospheric-vented drain chamber.
 - 7. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 - 8. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 - 9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
- B. Manufacturers:
 - 1. Josam Co.
 - 2. Smith, Jay R. Mfg. Co.
 - 3. Tyler Pipe; Wade Div.
 - 4. Zurn Industries, Inc.; Specification Drainage Operation.
- C. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
- D. Roof Flashing Assemblies: Manufactured assembly made of [4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-)] [6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-)] thick, lead flashing collar and skirt extending at least [6 inches (150 mm)] [8 inches (200 mm)] [10 inches (250 mm)] from pipe with galvanized steel boot reinforcement, and counterflashing fitting.

- E. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- F. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- G. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- H. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- I. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- J. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

2.8 SLEEVE PENETRATION SYSTEMS

- A. Manufacturers:
 - 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - 3. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.9 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.
 - 1. Not required to meet NSF International Standards for Lead Free.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Jay R. Smith: 5907.
 - 2) Prier: P-RH2.

- 3) Woodford: RHY2-MS.
3. Water Hammer Arrestors:
 1. Design Criteria:
 - 1) Meet NSF International Standards for Lead Free.
 - 2) Nesting type, air pre-charged bellows with casing.
 - 3) Bellows constructed of stabilized 18-8 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- C. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- D. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- C. 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.
- D. Connect plumbing specialties and devices that require power.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
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 motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 22 13 13

FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines **5 feet** out from building where applicable.
2. Perform excavation and backfill required by work of this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Cover Observation.

1. Contact Architect/Engineer prior to covering any section of pipe.
2. All piping all be under pressure during observation

1.3 REFERENCES

A. Reference Standards:

1. International Code Council:
 - a. ICC IPC-2012, 'International Plumbing Code'.

1.4 PERFORMANCE REQUIREMENTS

- ###### A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

- ###### A. Product Data: For pipe, tube, fittings, and couplings.
- ###### B. Shop Drawings: For solvent drainage system, include plans, elevations, sections, and details.
- ###### C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- ###### A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PVC PIPING

- ###### A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- ###### B. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.
- ###### C. Plenum Vent Lines: In areas of building with a return air plenum.
1. Approved Types:
 - a. Service weight, single-hub or no-hub type cast iron soil pipe meeting requirements of ASTM A74.
 - b. Vent lines **2-1/2 inches** or smaller may be Schedule 40 galvanized steel.

- c. Joint Material:
 - 1) Single-Hub: Rubber gaskets meeting requirements of ASTM C564.
 - 2) No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands.
- d. Fittings:
- e. Cast Iron Pipe: Hub and spigot, except fittings for no-hub pipe shall be no-hub, and meet requirements of ASTM A74.
 - 1) Joint Material: Rubber gaskets meeting requirements of ASTM C564.
 - 2) Galvanized Pipe: Screwed Durham tarred drainage type.

2.2 EXECUTION

2.3 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.
- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep $\frac{1}{4}$ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and $\frac{1}{8}$ - bend fittings if 2 fixture are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- E. Re-verify building drainage piping slope before covering pipe in trench if left uncovered over a 24 hour period of subjected to exterior water. If slope of piping has changed, provide new shoring material to maintain original slope after trench has been covered.
- F. Install soil and waste drainage and vent piping at the code required minimum slopes, unless otherwise indicated:
- G. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Cast-Iron, Solvent, Single Stack: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section "Plumbing Fixtures."
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger

2.5 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Conduct tests for leaks and defective work. Notify Architect before testing.
 - 2. Thermoplastic Pipe System:
 - a. Before backfilling and compacting of trenches, Fill waste and vent system with water to roof level or **10 feet** minimum, and show no leaks for two hours. Correct leaks and defective work.
 - b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.
- B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

2.6 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Products Furnished But Not Installed Under this Section as described in Contract Documents.
 - 1. Cleanouts.
 - 2. Floor drains.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 2. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
 - 1. Cleanouts, floor drains, and roof drains.
 - 2. Roof flashing assemblies.
 - 3. Grease interceptors(if applicable)
 - 4. Sleeve penetration systems.

PART 2 - PRODUCTS

2.1 SLEEVE PENETRATION SYSTEMS

- A. Manufacturers:
 - 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.2 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.3 CLEANOUTS

- A. Cleanouts: Comply with [ASME A112.36.2M] [ASME A112.3.1] <Insert other>.
 - 1. Application: [Floor cleanout] [Wall cleanout] [For installation in exposed piping].
 - 2. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc., Specification Drainage Operation.

2.4 FLOOR DRAINS

- A. Floor Drains.
 - 1. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- E. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

- G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- I. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- J. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- K. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- L. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Flush with In-Ground Installation: Set unit and extension, if required, with cover flush with finished grade.
 - 2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- M. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- N. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- O. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- C. 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.
- D. Connect plumbing specialties and devices that require power according to Division Sections.
- E. Interceptor Connections: Connect piping, flow-control fittings, and accessories.

1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
 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 motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install electric water heater as specified in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Plumbing Requirements'.
 - 2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Reference Standard:
 - 1. NSF International Standard / American National Standards Institute:
 - a. NSF/ANSI 61-2012, 'Drinking Water System Components - Health Effects'.
 - b. NSF/ANSI 372-2011, 'Drinking Water System Components - Lead Content'.

B. SUBMITTALS

- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data:
 - 1) Maintenance and operational instructions.
 - b. Warranty Documentation:
 - 1) Final, executed copy of Warranty.
 - c. Record Documentation:
 - 1) Manufacturers documentation:
 - a) Manufacturer's literature or cut sheet.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.

1.4 WARRANTY

- A. Special Warranty:
 - 1. Three-year non-prorated warranty on water heaters of 20 gallon capacity and larger.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. A O Smith Water Products Co,
 - b. Bradford-White Corp, Ambler,.
 - c. Rheem / Ruud Water Heater Div
 - d. Ruud Manufacturing Co.,

e. State Industries Inc,

B. Materials:

1. Design Criteria:

- a. All (wetted) drinking water products, components, and materials used in drinking water systems must meet NSF International Standards for Lead Free.
- b. All water heaters require 'Tempered Water Temperature Control' (mixing valves) as specified in Section 22 1116.

2. 30 Gallon to 50 Gallon Regular Height:

- a. Glass lined storage tank pressure tested and rated for 125 psi (862 kPa) working pressure.
- b. Water heaters shall each have ASME rated temperature-pressure relief valve rated at MBH input of heater minimum set to relieve at 120 psi (827 kPa).
- c. 9 Kw.
- d. 3 inches (75 mm) minimum glass fiber or polyurethane foam insulation.
- e. Complete with two stage thermostat, magnesium anode, electric sheath rod type heating element, and high limit control.
- f. Heater shall be pre-wired and entire unit bear UL label.
- g. Manufactures
 - 1) American:
 - 2) A O Smith:
 - 3) Bradford White:
 - 4) Rheem
 - 5) State Industries: SB6-40.

2.2 ACCESSORIES

A. Anchoring Components:

1. One inch (25 mm) by 18 ga (1.2 mm) galvanized steel straps.
2. No. 10 by 2-1/2 inch (64 mm) screws.

B. Thermal Expansion Absorbers:

1. Bladder type for use with potable water systems.

C. Type One Acceptable Products.

- a. Therm-X-Trol ST-12-C by Amtrol Inc, West Warwick, RI www.amtrol.com.
- b. Equal as approved by Architect before bidding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install temperature-pressure relief valve on hot water heater and pipe discharge to directly above funnel of floor drain.

3.2 ADJUSTING

- A. Set discharge water temperature at 140 deg F (60 deg C). Final hot water temperature shall be 110 deg F (43 deg C) after mixing valve. If no mixing valve set discharge temperature at 110 deg F (43 deg C).

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing fixtures and related components.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. TAS: Texas Accessibility Standards.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.

2.2 LAVATORY FAUCETS

- A. Lavatory Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Products:
 - a. American Standard.
 - b. Eljer.
 - c. Kohler.

2.3 SINK FAUCETS

- A. Sink Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Manufacturers:
 - a. American Standard.
 - b. Eljer
 - c. Kohler

2.4 TOILET SEATS

- A. Toilet Seat: Solid plastic.

1. Manufacturers:
 - a. Bemis.
 - b. Beneke.
 - c. Centoco.
 - d. Church.

2.5 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Guard, Manufactured, plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.

1. Manufacturers:
 - a. Engineered Brass Co.
 - b. Plumerex
 - c. Truebro.

2.6 FIXTURE SUPPORTS

- A. Water-Closet Support: Water-closet combination carrier designed for accessible and standard mounting heights. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

1. Manufacturers:
 - a. Mifab
 - b. Josam.
 - c. Wade.
 - d. Zurn

- B. Urinal Support: Not required
- C. Lavatory Support: Not required

- D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.
 - 1. Manufacturers:
 - a. Josam.
 - b. J.R. Smith
 - c. Zurn.

2.7 WATER CLOSETS

- A. Water Closets: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - 2. American Standard, Inc.
 - 3. Kohler Co.
 - 4. TOTO USA, Inc.
- B. Water Closets: Ligature Resistant Institutional Combination Lavatory/Toilet
 - 1. Products:
 - a. ACORN
 - b. All others shall be submitted for pre-approval prior to bid date.

2.8 LAVATORIES, SINKS

- A. Lavatories,: Accessible, counter top, vitreous-china fixture.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Toto
 - d. CRANE

2.9 SINKS

- A. Sinks: Commercial, counter-mounting, stainless-steel fixture.
 - 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.

2.10 SERVICE SINKS

- A. Service/Mop Sinks: Floor-mounting, enameled, sink with front apron, raised back, and coated, wire rim guard.
 - 1. Products:
 - a. Commercial Enameling Co.
 - b. Kohler Co.
 - c. Fiat

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install traps on fixture outlets.
- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
 - 1. 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.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 47 13

DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Drinking fountains.
 - 2. Self-contained water coolers.
 - 3. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain and Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler, unless one is specifically indicated.
- E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For fixtures to include in maintenance manuals specified in Division.

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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" about fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. TAS: Texas Accessibility Standards.

1.6 COORDINATION

- A. Coordinate roughing-in and final fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified below.
 - 1. Elkay.
 - 2. Halsey Taylor.
 - 3. Haws Corporation.

2.2 DRINKING FOUNTAINS

- A. Drinking Fountains,: Accessible, Style W, wall-hanging fixture made of stainless steel.
 - 1. Receptor Shape: Rectangular.
 - 2. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - 3. Bubblers: Two, with automatic stream regulator, located on deck.
 - 4. Control: Push button.
 - 5. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
 - 6. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
 - 7. Support: Type I, water-cooler carrier. Refer to "Fixture Supports" Article.

2.3 SELF-CONTAINED WATER COOLERS

- A. Water Coolers: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-hanging fixture.
 - 1. Cabinet: Bilevel with two attached cabinets, enameled steel with stainless-steel top.
 - 2. Bubbler: One, with automatic stream regulator, located on each cabinet deck.
 - 3. Control: Push button.
 - 4. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve and filter.
 - 5. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
 - 6. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - a. Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
 - b. Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
 - 7. Support: Type II, water-cooler carrier. Refer to "Fixture Supports" Article.

2.4 FIXTURE SUPPORTS

- A. Off-Floor, Plumbing Fixture Supports: ASME A112.6.1M, water-cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Available Manufacturers:
 - 2. Manufacturers:
 - a. Josam Co.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Specifications Drainage Operation.
 - 3. Type I: Hanger-type carrier with two vertical uprights.
 - 4. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 5. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Refer to Division Section "Valves" for general-duty valves.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Refer to Division Section "Basic Mechanical Materials and Methods" for escutcheons.
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division for sealant and installation requirements.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Ground equipment.
 - 1. 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.

END OF SECTION

SECTION 23 00 00

HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. Mechanical Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC
3533 Moreland Dr. Ste. A
Weslaco, Texas 78596
Phone Number: (956) 973-0500
Contact Person: Leonardo Munoz, P.E.

C. General Scope of Work:

1. Install AC equipment and ductwork as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect power to unit.
2. HVAC: Provide all materials and labor associated with a complete operational installation of new HVAC systems including, but not limited to:

- DX Split System A/C Units
- Exhaust fans
- Sheet metal, Ductwork
- Diffusers and Grilles
- Duct accessories, including grilles, and louvers
- Air Test and Balance

1.3 COORDINATION

- A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, even in areas where only mechanical work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

- E. Fully coordinate with electrical contractor for providing power to mechanical equipment.
- F. Mechanical Contractor is responsible for all control wiring including thermostat(s). This includes all conduit, wire, and accessories both low voltage and source voltage for the controls' system. Mechanical Contractor will provide all the necessary actuators, relays, software, hardware, and all necessary accessories required for a fully functional controls' system.

1.4 UTILITIES

- 1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
- 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.5 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
 - 3. Temporary fencing around equipment while site work is in progress.

1.6 SUBMITTALS

- 1. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire mechanical or plumbing in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Escutcheons.
 - 4. Dielectric fittings.
 - 5. Flexible connectors.
 - 6. Mechanical sleeve seals.
 - 7. Equipment nameplate data requirements.
 - 8. Nonshrink grout for equipment installations.
 - 9. Field-fabricated metal and wood equipment supports.
 - 10. Installation requirements common to equipment specification sections.
 - 11. Cutting and patching.
 - 12. Touchup painting and finishing.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
- G. PVC: Polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.

- B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 3. Sizes and location of required concrete pads and bases.
 - 4. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 5. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes, ductwork, equipment, and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in architectural section.

- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- C. The date of acceptance by the Engineer, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.9 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of mechanical equipment shown on the Drawings is based on the dimensions of a particular manufacturer as indicated. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the engineer to indicate a suitable arrangement.
- B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
- C. Provide access panels acceptable to the Engineer for equipment that is concealed above ceiling space.
- D. Large equipment assemblies or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Provisions shall be implemented by the Contractor to insure that the equipment will not be damaged in any way during the associated construction procedures.

1.10 START-UP OF EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.

- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include piping diagrams, valve identification charts, control and interlocking wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.
- D. Provide the Owner with three (3) complete sets of all maintenance manuals, pamphlets, brochures or instructions. This material shall be catalogued, indexed and bound into books.

1.12 ACCEPTABLE MANUFACTURERS

- A. A. Provide equipment and materials from listed manufacturers listed within this specification. Deviations from this specification will not be acceptable. When one manufacturer is listed, alternate materials and equipment may be provided "equal to" the listed. When more than one manufacturer is listed, equipment and material must be provided by one of the listed manufacturers.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

- A. Each item of equipment furnished under this Division of the Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same kind or class of equipment are required, these shall be the products of a single manufacturer; however, the component parts of the equipment need not be the products of one manufacturer.
- B. Materials and equipment shall be of the base quality normally used in good commercial practice, and shall be the products of reputable domestic manufacturers unless otherwise specified. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

2.2 QUALITY AND CLASSIFICATION OF MATERIALS

- A. Materials and equipment shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new materials or equipment identical with those damaged.
- B. Wherever a UL standard has been established for a particular type of material or equipment, each such material or equipment provided on this project shall meet the requirements of the UL standard in every way and shall be UL listed and labeled.

2.3 LOCAL PARTS AND SERVICE

- A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 50 miles of the project site."

2.4 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.5 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dielectric Unions:

- a. Watts Industries, Inc.; Water Products Div.
- b. Zurn Industries, Inc.; Wilkins Div.
- 2. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: One piece, with set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 - 4. Cast-Iron Floor Plate: One-piece casting.

2.8 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.

- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.
 - 5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe or pipe insulation and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions.
Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Note 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.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. 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.
 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. PVC Nonpressure Piping: ASTM D 2855.
 - c. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- W. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT AND MATERIAL INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment and material to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment and ductwork giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

- A. Refer to paint materials, surface preparation, and application of paint.
- B. Do not paint piping specialties with factory-applied finish.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement or as specified.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.

- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 29

HANGER & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:

- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 05 12 23 - Structural Steel for Buildings.
- .5 Section 05 50 00 - Metal Fabrications.

1.3 REFERENCES

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
 - .1 Materials Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.2 Performance Requirements

- .1 Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed for approval by Owner's Representative.
- .3 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Owner's Representative will make available 1 copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.6 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.

- .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.
- .4 Upper attachment to concrete.
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.
- .5 Shop and field-fabricated assemblies.
 - .1 Trapeze hanger assemblies: MSS SP-89.
 - .2 Steel brackets: MSS SP-89.
 - .3 Sway braces for seismic restraint systems: to MSS SP-89.
- .6 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation saddles for hot pipework.
 - .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-69.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.9 PLATFORMS AND CATWALKS

- .1 To Section 05 50 00 - Metal Fabrication.

2.10 HOUSE-KEEPING PADS

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-place Concrete by Division 3.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 From structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
10	6.6 m	
12	6.9 m	

- .6 Within 300 mm of each elbow.
- .7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Access panel and door markers.
 - 4. Pipe markers.
 - 5. Duct markers.
 - 6. Valve tags.

1.3 SUBMITTALS

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

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.

2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme [approved by Architect] <Insert other>. Provide 5/32-inch (4-mm) hole for fastener.

1. Material: 3/32-inch- (2.4-mm-) thick laminated plastic with 2 black surfaces and white inner layer.

2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Divisions. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate

nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 2. Heat exchangers, coils, evaporators, and similar equipment.
 3. Fans, blowers, primary balancing dampers, and mixing boxes.
 4. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 2. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices.
 - b. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - c. Heat exchangers, coils, evaporators, and similar equipment.
 - d. Fans, blowers, primary balancing dampers, and mixing boxes.

- e. Packaged HVAC central-station and zone-type units.
- f. Tanks and pressure vessels.
- g. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: Pretensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, **6 Inches (150 mm)** and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least **1-1/2 inches (38 mm)** wide, lapped at least **3 inches (75 mm)** at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of **50 feet (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 - 4. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of **50 feet (15 m)** in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:

- a. Cold Water: 1-1/2 inches (38 mm), round.
- b. Hot Water: 1-1/2 inches (38 mm), round.
- c. Fire Protection: 2 inches (50 mm), round.

C. Valve-Tag Color:

- a. Cold Water: Green.
- b. Hot Water: Yellow.
- c. Fire Protection: Red.

2. Letter Color:

- a. Cold Water: White.
- b. Hot Water: White.
- c. Fire Protection: White.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING & BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring electrical performance of HVAC equipment.
 - 4. Setting quantitative performance of HVAC equipment.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
 - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

- M. AABC: Associated Air Balance Council.
- N. CTI: Cooling Tower Institute.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.4 QUALITY ASSURANCE

- A. Agent Qualifications for larger projects: Engage a testing, adjusting, and balancing agent certified by AABC.
- B. Agent Qualifications for smaller projects: Engage a testing, adjusting, and balancing agent certified by NEBB.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
- E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
- G. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in specifications.
- D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 5. Sensors are located to sense only the intended conditions.
 6. Sequence of operation for control modes is according to the Contract Documents.
 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 8. Interlocked systems are operating.
 9. Changeover from heating to cooling mode occurs according to design values.
- N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, fire dampers are open.
 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 6. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.

- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
 - 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating if high-efficiency motor.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 HEAT-TRANSFER COILS

- A. Electric-Heating Coils: Measure the following data for each coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperatures at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kW at full load.
 6. Fuse or circuit-breaker rating for overload protection.

3.9 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure outside-air, wet- and dry-bulb temperatures.

3.10 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply and Exhaust Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.12 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
- F. Roof Top Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Number of belts, make, and size.
 - j. Number of filters, type, and size.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Preheat coil static-pressure differential in inches wg (Pa).
 - f. Cooling coil static-pressure differential in inches wg (Pa).
 - g. Heating coil static-pressure differential in inches wg (Pa).
 - h. Outside airflow in cfm (L/s).
 - i. Return airflow in cfm (L/s).
 - j. Outside-air damper position.
 - k. Return-air damper position.
 - l. Discharge air temperature
- G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btuh (kW).
 - e. Number of stages.

- f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Discharge air temperature
- 2. Test Data: Include design and actual values for the following:
 - a. Heat output in Btuh (kW).
 - b. Airflow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For exhaust fans, include the following:
 - 1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Number of belts, make, and size.
 - 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- I. Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Manufacturer's compressor serial numbers.
 - e. Compressor make.
 - f. Compressor model and serial numbers.
 - g. Refrigerant weight in lb (kg).
 - 2. Test Data: Include design and actual values for the following:
 - a. Entering-air, dry-bulb temperature in deg F (deg C).
 - b. Leaving-air, dry-bulb temperature in deg F (deg C).

- c. Control settings.
- d. Unloader set points.
- e. Low-pressure-cutout set point in psig (kPa).
- f. High-pressure-cutout set point in psig (kPa).
- g. Suction pressure in psig (kPa).
- h. Suction temperature in deg F (deg C).
- i. Condenser refrigerant pressure in psig (kPa).
- j. Condenser refrigerant temperature in deg F (deg C).
- k. Oil pressure in psig (kPa).
- l. Oil temperature in deg F (deg C).
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. The kW input.
- p. Number of fans.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Deliver and store all insulation with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
- C. Any installed insulation left temporarily incomplete shall be covered with protective material until final connections can be installed.

1.5 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

1.6 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film

2.3 Field Applied Jacket

- A. Foil and paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
 - 1. Tape Width: 4 inches (100 mm).
- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.

1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 2. Install anchor pins and speed washers on sides and bottom of horizontal ducts and all sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 3. Impale insulation over anchors and attach speed washers.
 4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
 6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
 7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
 8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
 9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

- C. Insulate the following plenums and duct systems:
 - 1. Indoor concealed supply-, return-, and outside-air ductwork.
 - 2. Indoor exposed supply-, return-, and outside-air ductwork.
 - 3. Indoor concealed range-hood exhaust ductwork.
 - 4. Indoor concealed dishwasher ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Factory-insulated flexible ducts.
 - 2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - 3. Flexible connectors.
 - 4. Vibration-control devices.
 - 5. Testing agency labels and stamps.
 - 6. Nameplates and data plates.
 - 7. Access panels and doors in air-distribution systems.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Round and rectangular, supply-air ducts, concealed.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 3 inches (R-8 or greater)
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and paper.
 - 5. Vapor Retarder Required: Yes.
- B. Service: Round and rectangular, return-air ducts, outside air duct, concealed or exposed.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 2 inches (50 mm).
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and Paper
 - 5. Vapor Retarder Required: Yes.
- C. Service: Round and rectangular, supply and return-air ducts, exposed and in mechanical rooms.
 - 1. Material: 2" liner insulation
 - 2. Thickness: 2 inches (50 mm).
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No
- D. Service: Round and rectangular, exhaust air ducts, concealed & exposed and in mechanical rooms.
 - 1. Material: 1" Interior liner
 - 2. Thickness: 1 inches
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No

END OF SECTION

SECTION 23 07 19 PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes preformed, rigid, and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 23 Section "Duct Insulation" for insulation for ducts and plenums.
 - 2. Division 23 Section "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
 - 3. Division 23 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.
 - 2. Cellular-Glass Insulation:
 - a. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - 3. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.

2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class 1.
 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- C. Closed-Cell Phenolic-Foam Insulation: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
- D. Flexible Elastomeric Thermal Insulation used on Refrigerant Piping: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Adhesive: As recommended by insulation material manufacturer.
 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil.
- C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.

- D. Aluminum Jacket: Factory cut and roll to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
 - 1. Finish and Thickness: Smooth finish, 0.010 inch (0.25 mm) thick.
 - 2. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and Kraft paper.
 - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Products:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
 - 1. Tape Width: 4 inches (100 mm).
- B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:
 - 1. Aluminum: 0.007 inch (0.18 mm) thick.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry during application and finishing.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the least number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

- L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Fire-stopping and fire-resistive joint sealers are specified in Division 7 Section "Fire-stopping."

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When pre-molded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
1. Apply pre-molded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 2. Apply insulation to flanges as specified for flange insulation application.
 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 CELLULAR-GLASS INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 2. When pre-molded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply pre-molded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 2. Apply insulation to flanges as specified for flange insulation application.
 3. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same thickness as pipe insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 2. When pre-molded sections of insulation are not available, apply mitered sections of phenolic-foam insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When pre-molded sections of insulation are not available, apply mitered sections of phenolic-foam insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without distributing insulation.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.7 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.
 - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
 - 1. Apply pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 - 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
 - 3. Apply insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.8 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 - 1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
 - 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
1. Draw jacket material smooth and tight.
 2. Apply lap or joint strips with the same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.
- C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.9 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
 2. Fire-suppression piping.
 3. Drainage piping located in crawl spaces, unless otherwise indicated.
 4. Below-grade piping, unless otherwise indicated.
 5. Chrome-plated pipes and fittings, unless potential for personnel injury.
 6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 2. Insulation Material: Mineral fiber
 3. Insulation Thickness: 1" thick
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: No
 6. Finish: None.
- B. Service: Rainwater conductors and roof drain bodies.
1. Operating Temperature: 32 to 100 deg F
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: 1" thickness
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: Yes.

6. Finish: None.
- C. Service: Condensate and equipment drain piping.
1. Operating Temperature: 40 to 60 deg F
 2. Insulation Material: Flexible elastomeric, only on first ten feet of pipe from trap.
 3. Insulation Thickness: 3/4"
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: No.
 6. Finish: Two coats of the insulation manufacturer's recommended protective coating.
- D. Service: Chilled-water supply and return.
1. Operating Temperature: 35 to 75 deg F
 2. Insulation Material: Pre-insulated piping, or Cellular glass, with jacket or Closed-cell phenolic foam.
 3. Insulation Thickness, Cellular glass: Apply the following insulation thickness:
 - a. Steel Pipe, 1.5" and smaller: 1.5"
 - b. Steel Pipe, 2" to 12": 2"
 4. Insulation Thickness, Closed-cell phenolic foam: Apply the following insulation thicknesses:
 - a. Steel Pipe, 1.5" and smaller: 1"
 - b. Steel Pipe, 2" to 4": 1.5"
 - c. Steel Pipe, 5" to 12": 2"
 5. Field-Applied Jacket: PVC on exposed ceiling , Aluminum Jacket on all exterior,
 6. Vapor Retarder Required: Yes.
 7. Finish: None.
- E. Service: Refrigerant suction and hot-gas piping.
1. Operating Temperature: 35 to 50 deg F
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- F. Service: Domestic water piping.
1. Operating Temperature: 60 to 80 deg F
 2. Insulation Material: Mineral Fiber
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- G. Service: For obtaining fire/smoke rating in return air plenum (cables, PE, PB, PP, ABS, PVC, CPVC, etc).

1. Operating Temperature: 35 to 90 deg F
2. Insulation Material: 3M Fire Barrier Plenum Wrap 5 A or equal.
3. Insulation Thickness: larger of 1" or mfr's recommendations.
4. Field-Applied Jacket: scrim reinforced foil
5. Vapor Retarder Required: None.
6. Finish: None.

3.11 EXTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic water.

1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses: 1"
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

B. Service: Refrigerant suction.

1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses: ½"
4. Field-Applied Jacket: Aluminum
5. Vapor Retarder Required: Yes.
6. Finish: None.

C. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F
2. Insulation Material: Pre-insulated piping, or Cellular glass, with jacket or Closed-cell phenolic foam.
3. Insulation Thickness, Cellular glass: Apply the following insulation thickness:
 - a. Steel Pipe, 1.5" and smaller: 1.5"
 - b. Steel Pipe, 2" to 12": 2"
4. Insulation Thickness, Closed-cell phenolic foam: Apply the following insulation thicknesses:
 - a. Steel Pipe, 1.5" and smaller: 1"
 - b. Steel Pipe, 2" to 4": 1.5"
 - c. Steel Pipe, 5" to 12": 2"
5. Field-Applied Jacket: Aluminum
6. Vapor Retarder Required: Yes.
7. Finish: None.

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1- GENERAL

1.1 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in Sequence of Operations for HVAC Controls" shall be BACnet objects.

1.2 APPROVED CONTROL SYSTEM MANUFACTURERS

- A. The following are approved control system suppliers, manufacturers, and product lines:

Supplier	Manufacturer	Product Line
Trane	Trane	Tracer SC

1.3 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications

- 1. Installer shall have an established working relationship with Control System Manufacturer.
- 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.4 ARCHITECTURE/COMMUNICATION

- A. Wireless equipment controllers and auxiliary control devices shall conform to:
- B. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
- C. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.
- D. To maintain robust communication, mesh networking and two-way communications shall be used to optimize the wireless network health.
- E. Certifications shall include FCC CFR47 - RADIO FREQUENCY DEVICES - Section 15.247 & Subpart E
- F. Shall be ZigBee Building Automation Certified to allow wireless integration with products from multiple suppliers.

1.4 GRAPHICS PACKAGE

- A. All floor plan graphics shall be represented in a 3D extruded wall thermograph.
- B. All equipment graphics shall by 3D representations of actual equipment at site.

1.5 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

1. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

B. Schedules:

1. Within one month of contract award, provide a schedule of the work indicating the following:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations.
2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

1.6 WARRANTY

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

1.8 TRAINING

- A. Provide training for a designated staff of Owner's representatives in two four hour sessions. Training shall be provided via web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components

- d. Understand system operation, including DDC system control and optimizing routines (algorithms)
- e. Operate the workstation and peripherals
- f. Log on and off the system
- g. Access graphics, point reports, and logs
- h. Adjust and change system set points, time schedules, and holiday schedules
- i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
- j. Understand system drawings and Operation and Maintenance manual
- k. Understand the job layout and location of control components
- l. Access data from DDC controllers and ASCs
- m. Operate portable operator's terminals

PART -2 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

2.1 SECTION INCLUDES:

- A. Single Zone VAV Air Handling Units
- B. IDF DX Fan Coil
- C. Exhaust Fan

2.2 MISCELLANEOUS CONTROL POINTS

Outdoor Air Temperature and Humidity:

A temperature and humidity sensor mounted on the north side of the building will continually broadcast their information on the network as global information

Building Exhaust Fan:

Temperature monitor of elevator equipment room served by minisplits. Alarms shall be provided as follows:

High Temp: When temp is above user defined setpoint an alarm will be initiated.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:

1.2 REFERENCES

A. Association Publications:

1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
 - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
 - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
 - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.

B. Definitions:

1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

C. Reference Standards:

1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ANSI/ASHRAE Standard 15-2010, 'Safety Standard for Refrigeration Systems'.
 - b. ANSI/ASHRAE Standard 34-2010, 'Designation and Classification of Refrigerants'.
2. American National Standards Institute / American Welding Society:
 - a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. '2011 ASHRAE Handbook - HVAC Applications'.
 - 1) Chapter 48, 'Noise and Vibration Control'.
4. ASTM International:
 - a. ASTM A36/A36M-08, 'Standard Specification for Carbon Structural Steel'.
 - b. ASTM B280-08, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.

5. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A-2012, 'Installation of Air Conditioning and Ventilating Systems'.
6. Underwriters Laboratories:
 - a. UL 2182, 'Refrigerants' (2nd Edition).

1.3 SUBMITTALS

- A. Action Submittals:
 1. Shop Drawings: Show each individual equipment and piping support.
- B. Informational Submittals:
 1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 1. Refrigerants:
 - a. Underwriters Laboratories / Underwriters Laboratories of Canada:
 - 1) Comply with requirements of UL 2182.
- B. Qualifications. Section 01 4301 applies, but is not limited to the following:
 1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Manufacturers:
 1. Manufacturer Contact List:
 - a. Airtec,
 - b. Cush-A-Clamp by ZSI Manufacturing,
 - c. Elkhart Products Corp.,
 - d. Emerson Climate Technologies,
 - e. Handy & Harman Products
 - f. Harris Products Group,
 - g. Henry Valve Co,
 - h. Hilti Inc,
 - i. Hydra-Zorb Co,
 - j. JB Industries,
 - k. Mueller Steam Specialty,
 - l. Nibco Inc,
 - m. Packless Industries, Parker Corp,
 - n. Sporlan Valve Co.
 - o. Sherwood Valves,,
 - p. Thomas & Betts,
 - q. Unistrut, Div of Atkore International, Inc.
 - r. Universal Metal Hose.
 - s. Vibration Mountings & Controls,
 - t. Virginia KMP Corp,
- B. Materials:
 1. Refrigerant Piping:
 - a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.

- b. Do not use pre-charged refrigerant lines.
- 2. Refrigerant Fittings:
 - a. Wrought copper with long radius elbows.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
- 3. Suction Line Traps:
 - a. Manufactured standard one-piece traps.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
- 4. Tee Access:
 - a. Brass:
 - 1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
- 5. Connection Material:
 - a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
 - 1) Copper to Copper Connections:
 - a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
 - 3) Do not use rods containing Cadmium.
 - b. Flux:
 - 1) Type Two Acceptable Products:
 - a) Stay-Silv White Brazing Flux by Harris Products Group.
 - b) High quality silver solder flux by Handy & Harmon.
 - c) Equal as approved by Architect before use. See Section 01 6200.
- 6. Valves:
 - a. Expansion Valves:
 - 1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
 - 2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
 - 3) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Emerson Climate Technologies.
 - b) Henry.
 - c) Mueller.
 - d) Parker.
 - e) Sporlan.
 - b. Manual Refrigerant Shut-Off Valves:
 - 1) Ball valves designed for refrigeration service and full line size.

- 2) Valve shall have cap seals.
- 3) Valves with hand wheels are not acceptable.
- 4) Provide service valve on each liquid and suction line at compressor.
- 5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
- 6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Henry.
 - b) Mueller.
 - c) Sherwood.
 - d) Virginia.
7. Filter-Drier:
 - a. On lines **3/4 inch (19 mm)** outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - b. On lines smaller than **3/4 inch (19 mm)** outside diameter, filter-drier shall be sealed type with brazed end connections.
 - c. Size shall be full line size.
 - d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Emerson Climate Technologies.
 - 2) Mueller.
 - 3) Parker.
 - 4) Sporlan.
 - 5) Virginia.
8. Sight Glass:
 - a. Combination moisture and liquid indicator with protection cap.
 - b. Sight glass shall be full line size.
 - c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
 - d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) HMI by Emerson Climate Technologies.
9. Flexible Connectors:
 - a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Vibration Absorber Model VAF by Packless Industries.
 - 2) Vibration Absorbers by Virginia KMP Corp.
 - 3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
 - 4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.
10. Refrigerant Piping Supports:
 - a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
 - b. Securing Channels:
 - 1) At Free-Standing Pipe Support:
 - a) Class One Quality Standard: P-1000 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 2) At Wall Support:

- a) Class One Quality Standard: P-3300 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- 3) At Suspended Support:
 - a) Class One Quality Standard: P-1001 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- 4) Angle Fittings:
 - a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- c. Pipe Clamps:
 - 1) Type Two Acceptable Manufacturers:
 - a) Hydra-Zorb.
 - b) ZSI Cush-A-Clamp.
 - c) Hilti Cush-A-Clamp.
 - d) Equal as approved by Architect before installation. See Section 01 6200.
- d. Protective Cover: 18 ga (1.2 mm) steel, hot-dipped galvanized.
- 11. Locking Refrigerant Cap:
 - a. Provide and install on charging valves:
 - 1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
 - 2) Acceptable Manufacturers: Airtec.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refrigerant Lines:
 - 1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
 - 2. Slope suction lines down toward compressor one inch/10 feet (25 mm in 3 meters). Locate traps at vertical rises against flow in suction lines.
- B. Connections:
 - 1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
 - 2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
 - 3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.
- C. Specialties:
 - 1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
 - 2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
 - 3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
 - 4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:

1. Support Spacing:

- a. Piping 1-1/4 inch (32 mm) And Larger: 8 feet (2.450 m) on center maximum.
 - b. Piping 1-1/8 inch (28.5 mm) And Smaller: 6 feet (1.80 m) on center maximum.
 - c. Support each elbow.
2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
 - a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
 - b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
 - c. Conduct tests at 70 deg F (21 deg C) ambient temperature minimum.
 - d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
 - e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
 - f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:

1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION

SECTION 23 26 00

CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:

1. ASTM International:
 - a. ASTM B88-09, 'Standard Specification for Seamless Copper Water Tube'.
 - b. ASTM D1785-12, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Materials:

1. Condensate Drains:
 - a. Exterior And Interior Lines: Type M copper meeting requirements of ASTM B88.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condensate Drains:

1. Support piping and protect from damage.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- B. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula $\text{Btu} \times \text{in.}/\text{h} \times \text{sq. ft.} \times \text{deg F}$ or $\text{W}/\text{m} \times \text{K}$ at the temperature differences specified. Values are expressed as Btu or W.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect.

1.5 SUBMITTALS

- A. Product Data: For duct liner and sealing materials.
- B. Shop Drawings: Show details of the following:
 - 1. Duct layout indicating pressure classifications and sizes on plans.
 - 2. Fittings.
 - 3. Penetrations through fire-rated and other partitions.
 - 4. Coordination with other trades and including but not limited to: structural members, electrical lights and conduits, plumbing lines, & fire sprinkler lines.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 - 2. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- D. Duct Construction Standards: Provide a copy of the duct construction standards to be used for each pressure classification in this project. Duct Construction Standards must comply with the latest edition of SMACNA "HVAC Duct Construction Standards – Metal and Flexible."
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.
- D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation
- D. Deliver and store all ductwork with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
- E. Any installed ductwork or piping system left temporarily incomplete shall be covered with protective material until final connections can be installed.
- F. All ductwork and/or liner insulation to be wrapped with protective material until installation. Any ductwork or insulation left exposed to the environment or contaminating particulate matter shall be replaced at the contractor's expense.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- C. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
- D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
 - 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 - 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.

2. Straps and Rod Sizes: Comply with latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.4 RECTANGULAR DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Fabricate range hood exhaust ducts with 0.0598-inch- thick, galvanized sheet for concealed ducts and 0.0500-inch- thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
- C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch- thick stainless steel. Weld and flange seams and joints.
- D. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 1. Supply Ducts between AHU and Air Terminal Units: 3-inch wg.
 2. Supply Ducts after air terminal units and on constant volume supply equipment: 1-inch wg (250 Pa), positive pressure
 3. Return Ducts: 1-inch wg ,negative pressure.
 4. Exhaust Ducts: 1-inch wg negative pressure.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.5 ROUND FABRICATION

- A. Round Ducts: Fabricate spiral seam supply and return ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Snap Lock Longitudinal seam ductwork will not be allowed. Adjustable elbows will not be allowed.
- B. Spiral seam round or oval duct may be substituted for rectangular duct at the contractors option. Spiral seam ductwork sizing must result in the same or less pressure drop than the rectangular duct indicated on the plans.

2.6 DUCT STORAGE

- A. All duct must have end capped with plastic covers on both ends from end of fabrication to duct installation. If this is not provided at the field, vacuum ducts before final acceptance to remove dust and debris.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 10 feet (3 m), unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division Section "Duct Accessories." Firestopping materials and installation methods are specified in other Divisions

3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." All duct to be sealed to SMACNA seal class A which requires sealing all transverse joints, longitudinal seams and duct wall penetrations regardless of pressure classification.
- B. Seal externally insulated ducts before insulation installation.
- C. All ducts shall be inspected after sealing is complete and prior to insulation installation. Provide the engineer with a minimum 7 days notice prior to beginning duct insulation.

3.3 RANGE HOOD EXHAUST DUCT INSTALLATIONS

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F temperature range.
- B. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at 15-foot intervals; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

3.4 DISHWASHER EXHAUST DUCT INSTALLATIONS

- A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.5 HANGING AND SUPPORTING

- A. Install rigid round and rectangular metal duct with support systems indicated in the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

3.6 CONNECTIONS

- A. Connect equipment with flexible connectors according to Section "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.7 DUCT APPLICATION

- A. Service: Round and rectangular, supply/return/outside -air ducts, concealed.
- B. Sheet-metal with wrap insulation
- C. Service: Round and rectangular, supply/return/outside -air ducts, exposed and in mechanical rooms.
 - 1. Sheet-metal double wall with lined insulation in-between.
 - 2. Inner sheet-metal duct shall be perforated in areas with acoustical requirements, ref. plans.

3.8 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
- B. 25% of the duct installed after the air handling units and (prior to the air terminal units, when applicable) shall be tested in the presence of the Architect, at static pressures equal to maximum design pressure of system or section being tested. The sections of duct to be tested shall be chosen by the architect or engineer after installation of the duct. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."
- D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.
- E. Remake leaking joints and retest until leakage is less than maximum allowable.

3.9 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system.

END OF SECTION

SECTION 23 33 00

HVAC DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors and panels.
 - 6. Flexible ducts.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible ducts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual- and automatic-volume-damper installations.
 - 2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
- D. Blade Seals: Vinyl.
- E. Blade Axles: Galvanized steel.
- F. Tie Bars and Brackets: Galvanized steel.
- G. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Tie Bars and Brackets: Galvanized steel.
- C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hours.
- C. Fire Rating: One and one-half hours.
- D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
- H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- I. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.
- F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.8 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Polyethylene film.
 - 3. Inner Liner: Polyethylene film.

- C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.9 ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
 - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division "Mechanical Identification."

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:

1. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A: 'Standard for the Installation of Air-Conditioning and Ventilating Systems' (2012 Edition).
2. Underwriters Laboratories:
 - a. UL 181, 'Factory-Made Ducts and Air Connectors' (10th Edition).
 - b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:

- a. Anco Products Inc,
- b. Thermaflex by Flexible Technologies
- c. Flexmaster USA Inc, Houston, TX

B. Materials:

1. Ducts:

- a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
- b. Insulation:
 - 1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
- c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
- d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) ANCO-FLEX 4625 by Anco Products.
 - 2) M-KC by Thermaflex by Flexible Technologies.
 - 3) Type 4m Insulated by Flexmaster.

2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.

PART 3 - EXECUTION

3.1 INSTALLATION

- ###### A. Install duct in fully extended condition free of sags and kinks, using 60 inch maximum lengths.

- B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes centrifugal fans and vent sets.

1.2 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA standards.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit scheduled and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For centrifugal fans to include in maintenance manuals specified in specifications.

1.4 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural support members and/or shaft locations.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in these documents.

1.7 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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cook, Loren Company.
 - 2. Greenheck.

2.2 HOUSINGS

- A. Roof Mounted Centrifugal Exhaust Fan.
 - 1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

2.3 WHEELS

- A. Roof Mounted Centrifugal Exhaust Fan
 - 1. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

2.4 SHAFTS

- A. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
- B. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
- C. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

2.5 BEARINGS

- A. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L₅₀ of 200,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L₅₀ of 200,000 hours.

2.6 BELT DRIVES

- A. Description: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor: 1.5.
- B. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
- C. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
- D. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
- E. Motor Mount: Adjustable for belt tensioning.

2.7 ACCESSORIES

- A. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
- B. Companion Flanges: Galvanized steel, for duct connections.
- C. Scroll Drain Connection: **NPS 1 (DN 25)** steel pipe coupling welded to low point of fan scroll.
- D. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
- E. Spark-Resistant Construction: AMCA 99 (where required).
- F. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
- G. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.8 MOTORS

- A. Refer to Section "Motors" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, high efficiency, Design B.
- C. Enclosure Type: [Open drip-proof] [Totally enclosed, fan cooled].

2.9 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label fans according to requirements specified in Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Ground equipment.
- D. 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. Equipment Startup Checks:
 1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Verify lubrication for bearings and other moving parts.
- B. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.
2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.
- H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.5 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 2. Review data in maintenance manuals. Refer to specifications Section "Closeout Procedures."
 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus.
 - 2. Price

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. Coordinate device locations with ceiling grid, sprinklers, and lights. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 23 73 12

DX AIR HANDLING UNITS, SINGLE ZONE VAV

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged air handling units.
- B. Refrigeration components

1.02 RELATED SECTIONS

- A. Section - Motors
- B. Section - Vibration Isolation.
- C. Section - Ductwork Insulation.
- D. Section - Ductwork.
- E. Section - Ductwork Accessories: Flexible duct connections.
- F. Section - Controls and Instrumentation
- G. Section - Equipment wiring systems.

1.03 REFERENCES

- A. ASHRAE 90.1 ENERGY STANDARD FOR BUILDINGS EXCEPT LOW RISE RESIDENTIAL BUILDINGS
- B. ANSI/AHRI 340/360 - PERFORMANCE RATING OF COMMERCIAL AND INDUSTRIAL UNITARY AIR CONDITIONING AND HEAT PUMP EQUIPMENT AND CONDENSING UNITS GREATER THAN 65,000BTUH AND BELOW 250,000BTUH
- C. AHRI 340 - Commercial and Industrial Unitary Heat-pump Equipment, (heat pumps above 135,000 Btuh).

1.04 QUALITY ASSURANCE

- A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

1.05 SUBMITTALS

- A. Submit unit performance data including: capacity, nominal and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.08 WARRANTY

- A. Provide one year parts warranty.

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install air handling units(s) as shown as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. **APPROVED MANUFACTURERS**
 - 1. Trane:
 - 2. Carrier:
 - 3. Lennox:
 - 4. Substitutions: [prior approval required] as indicated under the general and/or supplemental conditions of these specifications.

2.02 GENERAL

- A. Provide indoor-mounted, draw-thru, packaged air handling unit(s). Unit(s) shall be factory-assembled including direct-expansion evaporator coil, expansion valve(s), check valves, condensate drain pan, centrifugal fan assembly with fan motor(s) and mounting bracket sheaves, drives and belts, filters, and electrical controls. Units shall be suitable for either horizontal or vertical airflow configuration and be used with or without ductwork.

2.03 CASING

- A. Unit casing shall be constructed of zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned and finished with a baked enamel finish.
- B. Unit casing shall be completely insulated with fire-retardant, permanent, foil-faced, odorless glass fiber material.

2.04 FANS

- A. Provide fan section with forward curved, double width, double inlet, centrifugal type fan.
- B. Provide self-aligning, grease lubricated, ball or roller bearings with permanent lubrication fittings.
- C. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels.
- D. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- E. Provide cast iron or steel variable and adjustable pitched sheaves, dynamically balanced, bored to fit shafts and keyed.

2.05 COILS

- A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil. Enclose coils with headers and return bends fully contained within casing. Coil shall have factory installed expansion valves and factory pressure and leak tested at 375 psig.
- B. Provide double sloped condensate drain pan constructed of PVC with external connections on either side of unit. The drain pan shall be removable for cleaning.

2.06 MOTORS

- A. For additional static requirements, Odyssey Split Systems offer standard belt drive motors to meet and exceed a wide range of airflow needs.

2.07 FILTERS

- A. Provide one inch throwaway filters, factory installed. Provide access from side panel for removal. Filter rack shall be field convertible to two inch capability with field provided two inch

throwaway filters.

2.08 CONTROLS

- A. Provide factory installed and wired controls including fan contactor, low voltage terminal strip and single point power entry.
- B. Provide factory installed FROSTAT to prevent coil freezing at low evaporator temperatures.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install unit on vibration isolators.

END OF SECTION

SECTION 26 00 00

ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. General Scope of Work:
 - 1. Providing new panels, feeders, conduits, disconnect, fire alarm, rough-in for telephone and data system, and new light fixtures.

1.4 COORDINATION

- A. All electrical work shall be done under sub-contract to a General Contractor. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.
- B. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- C. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- D. Fully coordinate with mechanical contractor for providing power to mechanical equipment.

1.5 UTILITIES

- 1. Coordinate with power company and provide conduit, and trenching from transformer to power source. Coordinate with water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
- 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.6 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:

1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

1.7 SUBMITTALS

1. To expedite the submittal process more efficiently, do not piece-meal the submittals. Submit entire electrical in a bound enclosure. This will eliminate delays in the submittal process. Unbound submittals shall be returned without review. Submit 10 copies minimum.

END OF SECTION

SECTION 26 00 01

ELECTRICAL GENERAL REQUIREMENTS

PART1- GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, Specification Sections and all relevant documents shall form a part of this Section of the Specifications, and shall be incorporated in this Section and each Section 260000 hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Section. Certain specific paragraphs of said references may be referred to hereinafter in this Section. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.
- B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Section shall not be used as a basis for a request for additional compensation.
- C. The specific features and details for other portions of the work related to the construction in progress or to the adjacent building shall be determined by examination at the site.

1.2 SCOPE OF WORK

- A. The requirements contained in this Section apply to all work performed under these Specifications.
- B. The work covered by this Section of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.
- C. Refer to other Sections of the Specifications for related work.

1.3 DEFINITION OF "CONTRACTOR"

- A. Where the word "Contractor" is used under any Section of this Section of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section, even though this Contractor may be technically described as a Subcontractor, or an authorized representative.
- B. If the Contractor, engaged to execute a portion of the work, employs a Subcontractor to perform some of that work, he shall be completely responsible for the proper execution of this Subcontractor's work, in full conformity with the Contract Documents.

1.4 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor shall be responsible for all work of every description in connection with this Section of the Specifications. The Contractor shall specifically and distinctly assume, and does zeso assume, all risk for damage or injury from whatever cause to property or person used or

employed on or in connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.

- B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, the Contractor shall make report of such objections to the Owner's Representative, obtain proper approval and adjustment to the Contract, and shall proceed with the work.

1.5 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Section, complete for operation, unless specifically noted to the contrary.
- B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Section of the Specifications be similarly furnished, installed and connected under this Section, whether or not a phrase as described in the preceding paragraph has been actually included.
- C. Whenever the words "Owner's Representative" occurs, it is intended to refer to the Architect, Engineer and/or specific Owner's Representative responsible for or capable of providing the necessary direction pertaining to the referenced issue.

1.6 ORDINANCES, PERMITS AND CODES

- A. It shall be the Contractor's duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.
- B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.
- C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.
- D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.
- E. The work shall be in accordance with, but shall not be limited to, the requirements of:
 - 1 National Fire Protection Association
 - 2 National Electrical Code
 - 3 National Safety Code
 - 4 State of Texas Safety Code
 - 5 Local City Building Codes

6 State of Texas Building Codes

- F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

1.7 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

- A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.
- B. Materials, equipment and devices furnished under this Section of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.
- C. In describing the various materials, equipment and devices, in general each item will be described singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.
- D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.

1.8 QUALITY ASSURANCE

- A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner's Representative.
- B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

1.9 REFERENCE STANDARDS

- A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.
- B. In case of differences between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner's Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected of

noncompliance deficiencies with the Contractor bearing all costs.

- C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

AABM	-	American Association of Battery Manufacturers
ADA	-	American's with Disabilities Act
AIA	-	American Institute of Architects
ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing and Materials
CBM	-	Certified Ballast Manufacturers Association
ETL	-	Electrical Testing Laboratories
FM	-	Factory Mutual
ICEA	-	Insulated Cable Engineers Associated
IEEE	-	Institute of Electrical and Electronic Engineers
IES	-	Illuminating Engineering Society
IRI	-	Industrial Risk Insurance
NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NECA	-	National Electrical Contractors Association
NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electrical Safety Code
NETA	-	National Electrical Testing Association
NFPA	-	National Fire Protection Association
UL	-	Underwriters Laboratories

1.10 DRAWINGS AND SPECIFICATIONS

- A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:
- 1 The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.
 - 2 The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.
- B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:
- 1 If the Drawings and Specifications disagree in themselves, or with each other, the Contractor's pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated for a complete operable system.

Contractor is responsible to notifying the Architect and Engineer. In the event of this type of disagreement, the resolution shall be determined by the Owner's Representative. The contractor shall assume for an operable system at the most expensive combination as per the latest National Electrical Code. The contractor shall review all drawings and specifications prior to bid date.

- 2 The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Owner's Representative immediately, prior to bid date.
 - 3 In general, if there is conflict between the Drawings and Specifications, the Drawings shall govern the Specifications.
 - 4 Where the Specifications do not fully agree with schedules on the Drawings, the schedules shall govern. Actual numerical dimensions indicated on the Drawings govern scale measurements and large scale details govern small scale drawings.
 - 5 Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.
 - 6 Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.
- C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.
- D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Owner's Representative for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.
- E. Review the construction details of the building(s) as illustrated on the Drawings of the other portions of the work, i.e., architectural, structural, civil, landscape, etc., and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.
- F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. In cooperation with other Contractors, determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Owner's Representative, without additional cost to the Owner.
- G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and satisfactory operating installations. Prepare installation drawings as required for all critical areas illustrating the installation of the work in this Section as related to the work of all other Sections and correct all interferences with the other portions of the work or with the building structures before the work proceeds.

- H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work under this Section.

1.11 SUBMITTALS

- A. Submit product data and shop drawings in accordance with the Specifications.
- B. Process product data and shop drawings to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
- C. Submittals shall be provided for review and approval on all systems, equipment, devices and materials proposed for use on this project. Submittals shall include, but not be limited to, the following:
 - 1 Lighting and Appliance Panelboards
 - 2 Disconnect Switches
 - 3 Circuit Breakers and Fuses
 - 4 Materials: conduit, conductors, connectors, supports, etc.
 - 5 Lighting Fixtures, Lamps and Control Systems/Devices
 - 6 Wiring Devices
 - 7 Transformers
 - 8 Distribution Panelboards
 - 9 Motor Control Center
 - 10 As indicated on each submittal section
- D. The product data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
- E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform to Contract Documents.
- F. Assemble submittals on related items procured from a single manufacturer in bound brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
- G. Prepare shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner's Representative. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.
- H. The Contractor shall sign the submittal as an indication of compliance with the Contract Documents. If there are any deviations from the Contract Documents, he shall so indicate on the submittal. Any deviations not so indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

1.12 SUBSTITUTIONS

- A. Where a single manufacturer is mentioned by trade name or manufacturer's name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.
- B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.
- C. Manufacturers not listed will be considered for substitution prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum seven (7) business days prior to bid with each sub-paragraph noted with the comment, "compliance", "deviation", "alternate" or "not applicable". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.
 - 1 By noting the term "compliance" or "C", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
 - 2 By noting the term "deviation" or "D", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
 - 3 By noting the term "alternate" or "A", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the manufacturer proposes to provide.
 - 4 By noting the term "not applicable" or "N/A", it shall be understood that the specified item is not applicable to the project.
- D. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.
- E. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner's Representative, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
- F. The Owner's Representative reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.
- G. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal

of substitutions for the same item will not be considered.

1.13 INSTALLATION DRAWINGS

- A. Prepare installation drawings for coordinating the work of this Section with the work of other Sections, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.
- B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Owner's Representative for his information, review and record.

1.14 WORKMANSHIP AND INSTALLATION

- A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.
- B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.
- C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

1.15 INSPECTION OF SITE

- A. The accompanying drawings do not indicate existing installations other than to identify modifications of and extensions thereto. The Contractor shall visit the site, inspect the installations and ascertain the conditions to be met and the work to be performed. Failure to comply with this shall not constitute ground for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work under this Section.
- B. Review construction details of the adjacent building presently under construction during the site inspection and include all work required to modify the existing installations and install new materials, comprising a part of the installation. Review all construction details of the new building as illustrated on the drawings and be guided thereby.

1.16 WARRANTY

- A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Owner's Representative for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.
- B. The Contractor shall furnish to the Owner's Representative for transmittal to the Owner, the

name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

1.17 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

1.18 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers and/or technicians acceptable to the Owner's Representative to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

1.19 SCHEDULE AND SEQUENCE OF WORK

- A. The Contractor shall meet and cooperate with the Owner and Owner's Representative to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have no impact on the schedule.

1.20 INSTALLATION INSPECTIONS AND CERTIFICATIONS

- A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.
- B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Owner's Representative for transmission to the Owner.

1.21 EQUIPMENT INSTALLATION

- A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.
- B. Equipment specified to be factory assembled and tested prior to shipment shall not be

disassembled at the job site and reassembled at its final location. Apparatus not so specified may be disassembled and reassembled in the proper location.

- C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.

1.22 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads shall be provided for all floor mounted equipment, unless noted or required otherwise.
- B. All pads shall be not less than 3-1/2" high and extend a maximum 3" beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Pads shall be poured in forms built of new dressed lumber with corners chamfered using sheet metal or triangular wood strips nailed to the form. Use 6 x 6 No. 3 mesh for reinforcing. Install heavy duty adjustable anchor bolts, set in the form and positioned using templates, prior to pouring concrete. After the equipment is set on the pad, the equipment shall be aligned, leveled and fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.
- C. Perform all concrete work specified to be provided under this Section in strict accordance with the applicable provisions of Section, CONCRETE.

1.23 SLEEVES

- A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.
- B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.
- C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked and filled with an asphalt-base compound to insure a waterproof penetration. Jute twine caulking shall not be used due to susceptibility to termite infestation.

1.24 ESCUTCHEONS

- A. In each finished space, provided a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
- B. Size escutcheons and collars to fit snugly around conduit and rods.
- C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.25 ACCESS PANELS

- A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings.
- B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open

door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 12-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

1.26 SEALING OF PENETRATIONS

- A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:
 - 1 Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).
 - 2 Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.
 - 3 Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.
- B. Preparation: Remove combustible materials and loose impediments from penetration opening and involved surfaces. Remove free liquid and oil from penetration surfaces.
- C. Installation: In accordance with manufacturer's instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.
- D. In addition to the Dow Corning products, equal products by Spec Seal Firestop Products, 3M Fire Barrier or CS240 Firestop are acceptable.

1.27 PROTECTION OF APPARATUS

- A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc. or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Owner's Representative will be sufficient cause for the rejection of the pieces of apparatus in question.
- B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Section of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.
- C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.

1.28 INSTALLATION OF CONTROL AND OPERATING DEVICES

- A. The highest operable part of controls (light switches, dimmer switches, emergency power off devices, etc.), receptacles (electrical and communications) and other operable devices shall be 48" above finish floor. The lowest operable part shall be no less than 15" above finished floor. For purposes of uniformity, unless noted otherwise, the top of a device shall be maximum 48" AFF and the bottom of a device shall be minimum 15" AFF. Refer to the electrical symbols list on the Drawings for specific requirements.
- B. Visual alarm appliances shall be placed 80" above finished floor (the highest floor level within a

space) or 6" below the ceiling, whichever is lower.

1.29 INSTALLATION AND CONNECTION OF OTHER SECTION'S EQUIPMENT

- A. Verify the electrical requirements of all equipment furnished under other Sections, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc. as required for complete operation of all equipment.

1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

- A. The location of power, data and telephone outlets, wall switches and other related devices may be relocated at the Owner's option, at no additional cost to the Owner, to a point within 10 feet of their present location provided the Contractor is notified prior to installation.

1.31 COOPERATION AND CLEAN-UP

- A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and safe condition. Upon the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.
- B. After the installation is complete and before the equipment is energized, clean the interior and exterior of all equipment thoroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with lemon-oil rag after all other cleaning is complete. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

- A. The Contractor shall obtain at his own expense a complete set of blue-line prints on which to keep an accurate record of the installation of all materials, equipment and devices covered by the Contract. The Contractor shall record up to date information at least once a week and retain the set of prints on site for periodic review by the Architect/Engineer. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. If the Contractor prepared large scale installation drawings of electrical rooms, conduit routing, busduct, routing, etc., these drawings or reproducible copies therefrom shall be revised as required to accurately illustrate the actual installation. All conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location.
- B. Upon anticipated completion of the job, obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these record drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. This information shall be delivered prior to final acceptance.
- C. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring looseleaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Owner's Representative for review and subsequent delivery to the Owner prior to final acceptance.
 - 1 Warranties, guarantees and manufacturer's directions on material, equipment and devices covered by the Contract.
 - 2 Approved lighting fixture brochures, wiring diagrams and control diagrams.

- 3 Copies of approved submittals and shop drawings.
- 4 Operating instructions and recommended maintenance procedures for major apparatus.
- 5 Copies of all other data and/or drawings required during construction.
- 6 Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.
- 7 Tag charts and diagrams hereinbefore specified.

1.33 FINAL OBSERVATION

- A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative's opinion the installation is satisfactory for final acceptance by the Owner.
- B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Owner's Representative to make a final observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete equipment bases.
 - 7. Electrical demolition.
 - 8. Cutting and patching for electrical construction.
 - 9. Touchup painting.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

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. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Architectural documents.
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
- D. Slotted-Steel Channel Supports: Comply with Division Section "Metal Fabrications" for slotted channel framing.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
 - 1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
 - 2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 - 3. Color: Black letters on orange background.
 - 4. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
- D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend that indicates type of underground line.
- E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners **1/16-inch (1.6-mm)** minimum thickness for signs up to **20 sq. in. (129 sq. cm)** and **1/8-inch (3.2-mm)** minimum thickness for larger sizes. Engraved legend in black letters on white background.
- H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch (1-mm)**, galvanized-steel backing, with colors, legend, and size appropriate to the application. **1/4-inch (6-mm)** grommets in corners for mounting.
- J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
- C. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.
 - 1. Housing: NEMA 250, Type 3R enclosure.
 - 2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 10,000-A interrupting capacity, minimum.

2.4 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division Section "Cast-in-Place Concrete."
- B. Concrete: **3000-psi (20.7-MPa)**, 28-day compressive strength as specified in Division Section "Cast-in-Place Concrete."

2.5 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install raceways and cables at least **6 inches (150 mm)** away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

- F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least **1-inch (25-mm)** concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Install conduit larger than **1-inch trade size (DN27)** parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
 - 5. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
- G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of the pull wire.
- H. Install telephone and signal system raceways, **2-inch trade size (DN53)** and smaller, in maximum lengths of **150 feet (45 m)** and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of **72-inch (1830-mm)** flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
- J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of **200-lb (90-kg)** design load.

3.4 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install **1/4-inch- (6-mm-)** diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for **1-1/2-inch (38-mm)** and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than **24 inches (610 mm)** from the box.

- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Identify raceways and cables with color banding as follows:
 - 1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band **2 inches (51 mm)** wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 - 2. Band Locations: At changes in direction, at penetrations of walls and floors, at **50-foot (15-m)** maximum intervals in straight runs, and at **25-foot (8-m)** maximum intervals in congested areas.
 - 3. Colors: As follows:
 - a. Fire Alarm System: Red.
 - b. Security System: Blue and yellow.
 - c. Telecommunication System: Green and yellow.
- E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate **6 to 8 inches (150 to 200 mm)** below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed **16 inches (400 mm)**, overall, use a single line marker.
- G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Black.

2. Phase B: Red.
3. Phase C: Blue.
4. Neutral: White.
5. Ground: Green.

H. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Brown.
2. Phase B: Orange.
3. Phase C: Yellow.
4. Neutral: White with a colored stripe or gray.
5. Ground: Green.

I. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

J. Install engraved-laminated emergency-operating signs with white letters on red background with minimum **3/8-inch- (9-mm-)** high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.6 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.7 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division Section "Firestopping."

3.8 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than **4 inches (100 mm)** larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Concrete bases.
7. Electrical demolition.
8. Cutting and patching for electrical construction.

9. Touchup painting.
- B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
 1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
 2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
 3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
 5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.11 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division Section "Painting."
 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTOR AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.

- 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

- B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

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:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Wires and Cables:

- a. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.
 - d. Senator Wire & Cable Company.
 - e. Southwire Company.

- 2. Connectors for Wires and Cables:

- a. AMP Incorporated.

- b. General Signal; O-Z/Gedney Unit.
- c. Monogram Co.; AFC.
- d. Square D Co.; Anderson.
- e. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- E. Conductor Material: Copper.
- F. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- G. Plenum rated cable for all cables above the ceiling.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type RHW or THWN, in raceway.
- B. Feeders: Type 75C insulation THHN/THWN, in raceway.
- C. Fire-Pump Feeder: Type MI, 3-conductor.
- D. Branch Circuits: Type THHN/THWN, in raceway.
- E. Fire Alarm Circuits: Type THHN/THWN, in raceway.
- F. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- G. Class 2 Control Circuits: Type THHN/THWN, in raceway.
- H. Equipment or any device rated 100 amperes or less, conductor shall be rated 60C as per National Electrical Code.
- I. Equipment or any device rated over 100 amperes, conductor shall be rated 75C as per National Electrical Code.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Remove existing wires from raceway before pulling in new wires and cables.
- C. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary;

compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Section "Firestopping."
- H. Identify wires and cables according to Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to Section "Electrical Identification."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. 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.

3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes grounding and bonding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

- A. Revise this Article to suit Project and office practice. Frequently, no product submittal is required for this Section.
- B. Product Data: For each type of product indicated.
- C. Retain paragraph above if Product Data are required for each product specified. Retain paragraph below if Product Data are required only for selected products.
- D. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical rods.
 - 3. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency. Delete if Contractor is allowed to perform ground-resistance testing.
- 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.
 - 1. Comply with UL 467.

- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

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:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
 - 2. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erico Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Dossert Corp.
 - f. Erico Inc.; Electrical Products Group.
 - g. Framatome Connectors/Burndy Electrical.
 - h. Galvan Industries, Inc.
 - i. Hastings Fiber Glass Products, Inc.
 - j. Ideal Industries, Inc.
 - k. ILSCO.
 - l. Kearney/Cooper Power Systems.
 - m. Korns: C. C. Korns Co.; Division of Robroy Industries.
 - n. Lightning Master Corp.
 - o. Lyncole XIT Grounding.
 - p. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - q. Raco, Inc.; Division of Hubbell.
 - r. Robbins Lightning, Inc.
 - s. Salisbury: W. H. Salisbury & Co.
 - t. Superior Grounding Systems, Inc.
 - u. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section "Conductors and Cables."
- B. If only copper conductors are permitted in Division 16 Section "Conductors and Cables," delete paragraph below.
- C. Material: copper.
- D. Equipment Grounding Conductors: Insulated with green-colored insulation.

- E. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- F. Grounding Electrode Conductors: Stranded cable.
- G. Underground Conductors: stranded, unless otherwise indicated.
- H. Sizes and types below are typical. Adjust to suit Project conditions and requirements.
- I. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- J. Delete paragraph and subparagraphs below if use of aluminum conductors is not permitted.
- K. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 - 1. No. 4 AWG minimum, soft-drawn copper conductor.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- L. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Copper-clad steel is most common. See Evaluations for discussion on where other materials might be more appropriate.
- B. Ground Rods: Copper-clad steel.
 - 1. Select paragraph above or paragraph and subparagraph below. Sectional types are used when rods longer than 10 feet (3 m) are installed.
 - 2. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
- C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- D. Test Wells: Provide handholes as specified in Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION

- A. Delete paragraph below if only copper conductors are specified in Division 16 Section "Conductors and Cables."

- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. In raceways, use insulated equipment grounding conductors.
- D. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- F. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- G. Delete paragraph and subparagraphs below if grounding bus is not required, or edit to suit Project.
- H. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
- I. Edit below to suit Project.
- J. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. NEC permits two basic types of equipment grounding conductors: metallic raceway or cable sheath as the conductor, or a separate equipment grounding conductor. The installation of an equipment grounding conductor provides an additional degree of safe operation when compared to relying on raceway as the conductor. Revise paragraphs and subparagraphs in this Article to suit Project.
- B. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- C. Install equipment grounding conductors in all feeders and circuits.
- D. Select paragraph above or paragraph and subparagraphs below.
- E. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- F. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

- G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- H. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- I. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- J. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- K. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- L. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- M. Coordinate paragraph and subparagraphs below with Drawings and Specification Sections for systems referenced. Edit to suit Project.
- N. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- O. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.4 CONNECTIONS

- A. Coordinate paragraph and subparagraphs below with Drawings.
- B. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- C. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

- D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- F. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- G. Tighten screws and bolts for grounding and bonding 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.
- H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Retain one of three paragraphs below.
- B. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. NFPA 70 has minimum value of 25 ohms. See Evaluations for discussion on appropriate grounding resistance values. Values listed below are typical; adjust to suit Project conditions.
 - b. Equipment Rated 500 kVA and Less: 10 ohms.
 - c. Equipment Rated 500 to 1000 kVA: 5 ohms.

- d. Equipment Rated More Than 1000 kVA: 3 ohms.
 - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - f. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLANTING

- A. Delete below if inappropriate or if surface restoration work is covered on Drawings or in Division 2 Sections. Coordinate with Drawings.
- B. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with this sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of supporting devices, including related systems and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Unistrut Corp.
- B. B-Line Systems, Inc.
- C. Midland Ross-Kindorf

2.2 MATERIALS

- A. Suspension Hangers
 - 1. Suspension hangers for individual conduit runs shall be zinc plated formed steel type.
- B. Vertical Supports
 - 1. Malleable iron one hole pipe straps shall be used for vertical runs
- C. Clamps
 - 1. Beam clamps shall be used for bar joists and beams.
- D. Anti-Vibration Hangers
 - 1. Anti-vibration hangers shall be combination type having a double deflection neoprene element in series with a steel coil spring; double deflection of 0.30"; steel coil spring shall be selected from a 1" static deflection series with a minimum additional travel to solid of ½"; spring diameters shall be large enough to permit 15 degree angular misalignment of the rod connecting the hanger to the ceiling support without rubbing the hanger box.

2.3 LIGHT FIXTURE HANGERS

- A. Refer to Section 26 51 00
- B. Corrosive Areas: PVC; at factory apply a minimum of 10-mil-thick PVC coating, bonded to metal, inside and outside.Z

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hangers

1. Approved hangers and stiff leg supports shall be installed in quantity and size as required to carry the weight of raceway and contents and shall be arranged to prevent vibration transmission to the building and allow for raceway movement.
2. Hangers shall be supported by means of uncoated solid steel rods which are threaded to allow vertical adjustments. Lock nuts shall be provided in sufficient number and location to lock all rod adjustments permanently at the adjusted height. Two lock nuts shall be used unless the nut tightens against a threaded socket. Minimum rod diameters shall be as follows:

B. NOMINAL CONDUIT SIZE	ROD DIAMETER
--------------------------------	---------------------

1/2" through 2"	1/4"
-----------------	------

2-1/2" through 3"	3/8"
-------------------	------

4" and 5"	1/2"
-----------	------

1. Hanger spacing shall be as required for proper and adequate support raceway, but in no case shall be less than one hanger per 8'-0" of raceway length except that conduit less than 1" diameter shall be supported at least every 6'-0".
2. Where numerous conduits are run parallel to one another, they may be supported from a trapeze type hanger arrangement with strut bottom.
3. Anti-vibration type hangers shall be provided for equipment as required to minimize vibration and/or as directed by the Architect/Engineer.

Supports

4. Support of hangers shall be by means of sufficient quantities of individual after set steel expansion shields, or beam clamps attached to structural steel.
5. Stiff-legs shall be furnished and installed in cases where support from overhead structure is not possible.
6. Ceiling mounted lighting fixtures shall be supported from the building structure at two opposite corners. The Contractor shall provide fixture hangers to properly interface with the ceiling system.
7. Furnish and install complete any additional structural support steel, brackets, fasteners, etc., as required to adequately support all raceway and equipment.
8. Support of hangers from concrete slabs shall be by means of sufficient quantity of "U" brackets attached with after set expansion shields and bolts.
9. Support of hangers from concrete tees shall be by means of sufficient quantity of angle iron brackets attached with after set expansion shields and bolts.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Edit lists below to suit Project.
 - 2. Raceways include the following:
 - a. RMC.
 - b. IMC.
 - c. PVC externally coated, rigid steel conduits.
 - d. PVC externally coated, IMC.
 - e. EMT.
 - f. FMC.
 - g. LFMC.
 - h. LFNC.
 - i. RNC.
 - j. ENT.
 - k. Wireways.
 - l. Surface raceways.
 - 3. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.
- B. Related Sections include the following:
 - 1. List below only products and equipment for this Project that the reader might expect to find in this Section but are specified elsewhere. Verify that Section titles listed below are correct for this Project's Specifications because Section titles may have changed since this Section was updated.
 - 2. Section "Basic Electrical Materials and Methods" for raceways and box supports.
 - 3. Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RMC: Rigid metal conduit.

- H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Delete below except for custom enclosures.
- C. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

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:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflec Corp.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.
 - f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Wheatland Tube Co.
 - 2. Nonmetallic Conduit and Tubing:
 - a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arnco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Cantex Industries; Harsco Corp.
 - e. Certainteed Corp.; Pipe & Plastics Group.

- f. Cole-Flex Corp.
 - g. Condux International; Electrical Products.
 - h. Electri-Flex Co.
 - i. George-Ingraham Corp.
 - j. Hubbell, Inc.; Raco, Inc.
 - k. Lamson & Sessions; Carlon Electrical Products.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
 - 3. Conduit Bodies and Fittings:
 - a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
 - 4. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
- 2.2 METAL CONDUIT AND TUBING
- A. Rigid Steel Conduit: ANSI C80.1.
 - B. Rigid Aluminum Conduit: ANSI C80.5.
 - C. IMC: ANSI C80.6.
 - D. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw type.
 - E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.
- 2.3 NONMETALLIC CONDUIT AND TUBING
- A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
 - B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
 - C. LFNC: UL 1660.
- 2.4 METAL WIREWAYS
- A. Material: Sheet metal sized and shaped as indicated.
 - B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 - D. Select 1 of 4 paragraphs below.
 - E. Wireway Covers: Screw – cover type flanged-and-gasketed type.
 - F. Finish: Manufacturer's standard enamel finish.
- 2.5 OUTLET AND DEVICE BOXES
- A. Sheet Metal Boxes: NEMA OS 1.

- B. Edit paragraph below. Aluminum is also available and suitable for use with steel raceways.
- C. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.
- 2.6 PULL AND JUNCTION BOXES
 - A. Small Sheet Metal Boxes: NEMA OS 1.
 - B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- 2.7 ENCLOSURES AND CABINETS
 - A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
 - B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Use a comprehensive wiring method schedule on Drawings or use this Article to specify where various raceway types are to be installed. Edit examples below, adding or deleting materials and methods to suit Project. Coordinate with Division 16 Section "Wires and Cables." Do not duplicate information on Drawings, in NFPA 70, or in other Division 16 Sections. List exceptions to stated requirements. Check code to avoid specifying uses not permitted.
- B. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R .
- C. Indoors: Use the following wiring methods:
 - 1. Exposed: EMT.
 - 2. Concealed: EMT.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 - 6. Damp or Wet Locations: Rigid steel conduit.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Select 1 of 2 subparagraphs below and add other specific box and enclosure requirements to suit Project.
 - b. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Select paragraph above or below.
- C. Minimum Raceway Size: **3/4-inch trade size (DN21)**.
- D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- E. Keep raceways at least **6 inches (150 mm)** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Install raceways level and square and at proper elevations. Provide adequate headroom.
- G. Complete raceway installation before starting conductor installation.
- H. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- I. Use temporary closures to prevent foreign matter from entering raceways.
- J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- K. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- L. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- M. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- N. Raceways Embedded in Slabs (Must be indicated on drawings to be embedded. Please notify Engineer if required but not shown): Install in middle third of slab thickness where practical, and leave at least **1-inch (25-mm)** concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than **1-inch trade size (DN27)** parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- O. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- P. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- Q. Tighten set screws of threadless fittings with suitable tools.
- R. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- T. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of the pull wire.
- U. Telephone and Signal System Raceways, **2-Inch Trade Size (DN53)** and Smaller: In addition to the above requirements, install raceways in maximum lengths of **150 feet (45 m)** and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- V. Delete paragraph below if not applicable.
- W. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- X. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used **6 inches (150 mm)** above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- Y. Flexible Connections: Use maximum of **6 feet (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures; 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 across flexible connections.
- Z. Delete paragraph below if no high-frequency installation.
- AA. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in a nonmetallic sleeve.
- BB. Do not install aluminum conduits embedded in or in contact with concrete.
- CC. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
- DD. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
 - 1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
 - 2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
 - 3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.

4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.

EE. Set floor boxes level and adjust to finished floor surface.

FF. Select paragraph above for metal floor boxes and below for nonmetallic floor boxes.

GG. Set floor boxes level and trim after installation to fit flush to finished floor surface.

HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

- II. NO PVC CONDUIT ALLOWED ABOVE THE CEILING OR IN THE A/C RETURN PLENUM. PROVIDE RIGID CONDUIT. Verify all MEP documents.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with ELECTRICAL Sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of electrical identification, including related accessories.
- B. Provide electrical identification for the following:
 - 1. Panelboards, motor starters, contactors, disconnect switches, circuit breakers and other electrical equipment with nameplate identifying the item of equipment and the equipment serving the same.
 - 2. Raceways, junction boxes and pull boxes.
 - 3. Label each panelboard index indicating the room #s to the related circuit. Also add the index sheet in a laminated white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.
 - 4. Wiring devices.
 - 5. Wiring.
 - 6. Three phase motor rotation.

1.3 SUBMITTALS

- A. Submit product data in accordance with Section for products specified under PART 2 - PRODUCTS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Brady
- B. Panduit
- C. Thomas & Betts
- D. Seton

2.2 IDENTIFICATION

- E. A. Nameplates
 - 1. Nameplates shall be black engraved surface on white core for normal power circuits and red engraved surface on white core for emergency power circuits.
 - 2. Provide for each distribution panelboard, branch circuit panelboard, transformer and any other similar equipment furnished under this section identification as to its given name, voltage and origination of service. Examples are as follows:

‘LR1’
120/240V
FED FROM ‘MDP’

‘LR2’
120/240V
FED FROM ‘MDP’

- 'AHU-1' 'CU-1'
FED FROM 'MDP' FED FROM 'MDP'

- ## PART 3 - EXECUTION

A. Surfaces to receive labels or nameplates shall be carefully prepared in accordance with the manufacturer's instructions and recommendations.

J. A.Nameplates shall be properly attached to identify panelboards, feeder circuit breakers, disconnect switches, pull boxes and other similar equipment furnished under this section.

K. A. Wire markers shall be applied to each conductor or cable within panelboards, motor starter enclosures, circuit breaker enclosures, disconnect switches, cabinets, junction boxes, pull boxes, and other similar equipment identifying the serving equipment and feeder or branch circuit from which the conductors originate.

IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 53 - 2/2

SECTION 26 05 73.13

SHORT-CIRCUIT STUDIES

1.1 SUMMARY

- A. Section includes a computer-based, short-circuit study to determine the minimum required short-circuit ratings for all electrical equipment.

1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional or qualified engineer in charge of performing the study and documenting recommendations.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Submit information on computer software program to be used for studies.
 - 2. Submit the following after the approval of system submittals. Submittals **[shall]** **[may]** be in digital form.
 - a. Short-circuit study input data, including completed computer program input data sheets.

- b. Short-circuit study and equipment duty evaluation report; signed and dated by a professional or qualified engineer.
 - 1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If completion of studies will cause delay in equipment manufacturing, obtain approval from Owner for preliminary submittal of sufficient accuracy to ensure that selection of devices and associated characteristics is satisfactory. All assumptions made in a preliminary submittal shall be clearly identified.
 - 2) Revised one-line diagram, reflecting any discrepancies noted or updates required based on data collected for the study.
 - 3) Study report shall include documentation of all equipment data used in the short-circuit and equipment duty analysis.
 - 4) Study shall include a detailed listing of any electrical equipment found to be underrated for the calculated fault duty.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

- 1. For Power Systems Analysis Software.
- 2. For Power System Analysis Specialist.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

- 1. Final Short-Circuit Study Report:
 - a. Final one-line diagram.
 - b. Final Equipment Duty Report.
 - c. Short-circuit study data files.
 - d. Power system data.
 - e. Software data file in electronic format compatible with the software version used in the study.
 - f. Software library data used for the study.

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed electrical power system analysis software.
- B. Software algorithms and methodology shall comply with requirements of applicable standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

1. Power System Analysis Software Qualifications: Computer program shall be designed to perform ANSI and IEC based short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
- D. Power Systems Analysis Specialist Qualifications: Professional Engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this Professional Engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EasyPower, LLC software with ANSI ShortCircuit, IEC ShortCircuit, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
 1. CGI CYME.
 2. Power Analytics, Corporation.
 3. **<Insert manufacturer's name>.**
- B. Comply with IEEE 399 and IEEE 551.
 1. Analytical features of power systems analysis software program shall have capability as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Detailed list of all electrical equipment found to be underrated for the available short-circuit current.
- C. Recommendations for resolving any issues found with underrated equipment.
- D. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- E. One-line diagram of modeled power system, indicating the following:
 1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.

3. Transformer size and impedance.
4. Motor and generator designations and ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Any revisions to electrical equipment required by the study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment short-circuit ratings exceed available short-circuit current based on the applicable standards.
2. Tabulations of circuit breaker, fuse, and other protective device short-circuit ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated $1/2$ -cycle symmetrical fault current.

G. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Utility or incoming power short-circuit data.
3. Manufacturer, model, and short-circuit rating of protective devices.
4. Conductors.
5. Transformer data.

H. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and single line to ground fault calculations, indicating the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Multiplying factor.
2. High-Voltage Momentary Short-Circuit Report: Three-phase and single line to ground fault calculations, indicating the following for each equipment location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 2.6.
3. High-Voltage Interrupting Short-Circuit Report: Three-phase and single line to ground fault calculations, indicating the following for each equipment location:
 - a. Voltage.

- b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
- 4. Equipment Duty Report: For each protective device, indicate short-circuit ratings and calculated equipment duty for both ½ cycle and interrupting ratings as applicable. Calculated duty must automatically take into account any necessary derating factor due to the system X/R ratio and based on the actual maximum fault current through each device rather than the total bus fault current. All calculations to be based on the specific applicable test standards for each device such that no further interpretation of the results is necessary.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Owner's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 - 3. For **[equipment that] [relocated equipment and that which]** is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or their representative. Data must include, but not be limited to, the following:
 - 1. Product Data for Project's overcurrent protective devices. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at each service from the serving utility.
 - 3. For transformers, include kVA ratings, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 4. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents in accordance with IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin the scope of the short-circuit current and equipment duty analysis at the service, extending down to system overcurrent protective devices as follows:
 1. Down to and including all three-phase panelboards at voltages 208 V ac or higher.
 2. **<Insert description>.**
- F. For systems with multiple sources or multiple operating conditions, evaluate short-circuit and equipment duty for multiple scenarios as necessary to determine the maximum short-circuit current at each location.
- G. Analysis software must factor in ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply this to the short-circuit and equipment duty calculations as recommended by applicable standards. Also account for the fault-current dc decrement to address asymmetrical current ratings of applicable electrical equipment and components.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
- I. Equipment duty report must clearly indicate any protective device that is being applied outside its short-circuit rating.
- J. For any equipment found to be underrated, the report shall include recommendations for resolving this deficiency.

END OF SECTION 260573.13

SECTION 26 05 73.19

ARC-FLASH HAZARD ANALYSIS

1.1 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.2 DEFINITIONS

- A. 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.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

- A. Product Data: Submit information regarding computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.

2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 1. For Power Systems Analysis Software Developer.
 2. For Power System Analysis Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

- A. Arc-Flash Hazard Analysis:
 1. Provide final arc-flash hazard analysis report in hard copy and digital format.
 2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
 3. Provide library files for power system analysis software used to perform study.

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Computer program shall be designed to perform arc-flash analysis.
- E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting

recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.

- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
- B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.
- C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, indicating the following:
 - 1. Protective device designations, locations, and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Utility sources.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."

- F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.
- G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.
- H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.
- I. Arc-Flash Study Calculations and Output Reports:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
- J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

- A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
 - 1. Minimum Size: 6 inches (150 mm) wide by 4 inches (100 mm) high.
 - 2. Sample label submitted for review prior to printing of actual labels.
- B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
 - 1. Equipment ID.
 - 2. Nominal voltage.
 - 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 - 4. Available incident energy.
 - 5. Working distance.
 - 6. Engineering report number, revision number, and issue date.

- C. Completely machine printed, no field-applied markings.
- D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.
- B. Study all operating scenarios to determine the maximum incident energy at each location.
- C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all locations in electrical distribution system where personnel could service or examine equipment while energized.
- D. Include all three-phase medium- and low-voltage equipment locations.
- E. Calculate the limited and restricted approach boundaries for each location.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.
- G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.

- H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner's attention.
 - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance or available short-circuit current at each service.
 - 3. Short-circuit current at each system bus (three phase and line to ground).
 - 4. Voltage level at each bus.
 - 5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.
 - 6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 - 7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.
 - 8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.

10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower.
12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Low voltage transformers.
 6. Panelboard.
 7. Safety switch.
 8. Fused disconnect switch.
 9. Enclosed circuit breaker.
 10. Adjustable frequency drive.
 11. Control panel.

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROLS

PART 1 – GENERAL

1.0 SECTION INCLUDES

- A. Network lighting control system and components:
 - 1. Touch panel controls
 - 2. Lighting management panels
 - 3. Lighting management modules
 - 4. Low voltage wall stations
 - 5. Power interfaces
 - 6. Wired sensors

1.1. RELATED DOCUMENTS

- A. Section 262726 Wiring Devices
- B. Section 260923 Lighting Control Devices
- C. Section 260943.13 Digital-Network Lighting Controls
- D. Section 260943.16 Addressable Fixture Lighting Control
- E. Section 260943.19 Wireless Network Lighting Controls
- F. Section 265113 Interior Lighting Fixtures

1.2. SUMMARY

- A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers will be capable of “dimming lights to off”
- C. All system devices shall be networked together, enabling digital communication between devices, and shall be individually addressed.
- D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity, even if network connectivity to the greater system is lost.
- E. The system architecture shall facilitate remote operation via a computer connection.
- F. The system shall not require any centrally hardwired switching equipment.
- G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

1.3 SUBMITTALS

- A. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature)
- B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)

LIGHTING CONTROLS

- C. Other Diagrams – as needed for special operation or interaction with other system(s)
- D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- E. Hardware and Software Operation Manuals
- F. Other operational descriptions as needed

1.4 PROJECT CLOSEOUT DOCUMENTATION

- A. Provide a factory published manual
 - 1. Warranty
 - 2. Technical support contact
 - 3. Electronic manual on manufacturer's website for free download

1.5 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in North America; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

- A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
 - 2. Relative Humidity less than 90% non-condensing
- B. Standard electrical enclosures are permanently installed
- C. Equipment is protected from dust, debris and moisture

1.7 WARRANTY

- A. Five (5) year 100% parts replacement

1.8 MAINTENANCE & SUSTAINABILITY

- A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user
- B. Provide free telephone technical support

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable: Acuity Brands Lighting, Inc. – System: nLight by Acuity Controls

LIGHTING CONTROLS

- B. Basis of controls design Manufacturer: **Acuity Brands, One Lithonia Way, Conyers GA 30012, www.acuitycontrols.com**
- C. Substitutions: Not Permitted {Under Division 1}:
 - 1. All substitutions must be submitted in writing for approval at least 14 days prior to bid date.
 - 2. Proposed substitute products must be documented with a line by line compliance review

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see *Networked LED Luminaire* section).
- D. Intelligent lighting control devices shall communicate digitally, require <7 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, controls enabled luminaires, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

- K. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
 - L. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
 - M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.
 - N. WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.
 - O. WiFi-enabled devices shall be capable of current monitoring
 - P. WiFi-enabled devices shall utilize WPA2 AES encryption
 - Q. WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks
 - R. WiFi-enabled devices shall have two local RJ-45 port for communicating with non WiFi-enabled system devices
 - S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.
 - T. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
 - U. Devices located in different lighting zones shall be able to communicate occupancy, photocell (non-dimming), and switch information via either the wired or WiFi backbone.
 - V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week, utilization of a space.
- Note: Operating modes should be utilized only in manners consistent with local energy codes.

1. Auto-On / Auto-Off (via occupancy sensors)
 - Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
2. Manual-On / Auto-Off (also called Semi-Automatic)
 - Pushing a switch will turn lights on.
 - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
3. Manual-On to Auto-On/Auto-Off
 - Pushing a switch will turn lights on.

LIGHTING CONTROLS

- After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
 - Sequence can be reset via scheduled (ex. daily each morning) events.
4. Auto-to-Override On
 - Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - Zone lighting then goes into an override on state for a set amount of time, or until the next time event returns the lighting to an auto-off style of control.
 - Sequence can be reset via scheduled (ex. daily each morning) events.
 5. Manual-to-Override On
 - Pushing a switch will turn lights on.
 - Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - Sequence can be reset via scheduled (ex. daily each morning) events.
 6. Auto On / Predictive Off
 - Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - Pressing the switch will turn the lights off and a short “exit timer” begins. After the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
 7. Multi-Level Operation (multiple lighting levels per manual button press)
 - Operating mode designed specifically for bi-level applications.
 - Enables the user to cycle through up to four potential on/off/dim low/dim high lighting states using only a single button.
 - Eliminates user confusion as to which of two buttons controls which load
 - Three different transition sequences are available in order to comply with energy codes or user preference).
 - Mode available as a setting on all devices that have single manual on/off switch (ex. nPODM, nPODM-DX, nWSX LV).
 - Depending on the sequence selected, every button push steps through relay/dimming states according to below table
 - In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.

		State of load after each pushbutton press			
MLO Mode		1st Press	2nd Press	3rd Press	4th Press
2-State (Alternating)	Load A	On	Off	Off	-
	Load B	Off	On	Off	-
2-State (Both On, A First)	Load A	On	On	Off	-
	Load B	Off	On	Off	-
2-State (Both On, B First)	Load A	Off	On	Off	-
	Load B	On	On	Off	-
3-State	Load A	On	Off	On	Off
	Load B	Off	On	On	Off
A and B On ¹	Load A	On	Off	-	-
	Load B	On	Off	-	-
A On Only ¹	Load A	On	Off	-	-
	Load B	Off	Off	-	-
A and B On & Dim High ¹	Load A	High	Off	-	-
	Load B	High	Off	-	-
Dim Low /High	Load A	Low	High	Off	-
Dim Low / High	Load A	High	Low	Off	-

NOTE 1: Modes for use only when Auto-On state of Load A & B is different than first MLO state

- W. A taskbar style desktop application shall be available for personal lighting control.
- X. An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.
- Y. Control software shall enable logging of system performance data and presenting this information in a web-based format and downloadable to .CSV files.
- Z. Control software shall enable integration with a BMS via BACnet IP, although a hardware BACnet IP integration solution is also available.
- AA. System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control module (gateway)

1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet network.
2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
3. Control device shall have three RJ-45 ports for connection to the graphic touch screen, other backbone devices bridges) or directly to lighting control devices(up to 128 per port).

LIGHTING CONTROLS

4. Device shall automatically detect all devices downstream of it.
5. Device shall have a standard and astronomical internal time clock.
6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
7. Device shall have a USB port
8. Each control gateway device shall be capable of linking 1500 devices to the management software, with reduced memory version capable of support up to 400 devices.
9. Device shall be capable of using a dedicated static or DHCP assigned IP address.
10. Network Control Gateway device shall be the following nLight model Series:

nGWY2

B. Networked system occupancy sensors

1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
7. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

LIGHTING CONTROLS

10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
17. Wall switch sensors shall have optional features for photocell/daylight override, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.
20. Wall switch sensors shall be the following nLight model numbers, with device color and optional features as specified:
 - nWSX** (PIR, 1 Relay)
 - nWSX PDT** (Dual Tech, 1 Relay)
 - nWSX LV** (PIR, No Relay)
 - nWSX PDT LV** (Dual Tech, No Relay)
 - nWSX LV NL** (PIR w/ Night Light, No Relay)
 - nWSX PDT LV NL** (Dual Tech w/ Night Light, No Relay)
 - nWSX LV DX** (PIR, No Relay, Raise/Lower Dim Ctrl)
 - nWSX PDT LV DX** (Dual Tech, No Relay, Raise/Lower Dim Ctrl)
21. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
22. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
23. Embedded sensors shall have an optional photocell
24. Embedded sensors shall be the following nLight model number:
 - nES 7** (PIR, No Relay)
 - nES 7 ADCX** (PIR w/ Photocell, No Relay)

LIGHTING CONTROLS

nES PDT 7 (Dual Technology, No Relay)

nES PDT 7 ADCX (Dual Technology w/ Photocell, No Relay)

25. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
26. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
27. Sensors shall be the following nLight model numbers, with device options as specified:

Model # Series	Occupancy Poles	# of Relays	Lens Type	Detection Technology
nCM(B) 9	1	-	Standard	PIR
nCM(B) 9 2P	2	-	Standard	PIR
nCM 9 RJB	1	-	Standard	PIR
nCM 9 2P RJB	2	-	Standard	PIR
nCM(B) PDT 9	1	-	Standard	Dual
nCM(B) PDT 9 2P	2	-	Standard	Dual
nCM PDT 9 RJB	1	-	Standard	Dual
nCM PDT 9 2P RJB	2	-	Standard	Dual
nCM(B) 10	1	-	Extended	PIR
nCM(B) 10 2P	2	-	Extended	PIR
nCM 10 RJB	1	-	Extended	PIR
nCM 10 2P RJB	2	-	Extended	PIR
nCM(B) PDT 10	1	-	Extended	Dual
nCM(B) PDT 10 2P	2	-	Extended	Dual
nCM PDT 10 RJB	1	-	Extended	Dual
nCM PDT 10 2P RJB	2	-	Extended	Dual
nRM 9	1	-	Standard	PIR
nRM PDT 9	1	-	Standard	Dual
nRM 10	1	-	Extended	PIR
nRM PDT 10	1	-	Extended	Dual
nRM 6	1	-	High Bay	PIR
nRM 50	1	-	Aisle Way	PIR
nWV 16	1	-	Wide View	PIR
nWV PDT 16	1	-	Wide View	Dual
nHW13	1	-	Hallway	PIR
nCM(B) 6	1	-	High Bay	PIR
nCM 6 RJB	1	-	High Bay	PIR

C. Networked system daylight (photocell and/or dimming) sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
5. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
6. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
7. Sensor shall be the following nLight model numbers, with device options as specified:

nCM(B) PC (RJB) (on/off)

nCM(B) PC DZ (RJB) (on/off control, dual zone)

nCM(B) ADCX (RJB) (remote automatic dimming control photocell)

nCM(B) ADCX DZ (RJB) (remote automatic dimming control photocell, dual zone)

nRM PC (on/off)

nRM PC DZ (on/off, dual zone)

nRM ADCX (remote automatic dimming control photocell)

nRM ADCX DZ (remote automatic dimming control photocell, dual zone)

8. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
9. Embedded sensors shall be the following nLight model number:
nES ADCX (Dimming Photocell)

D. Networked System Power (Relay) Packs

1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.

LIGHTING CONTROLS

3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
7. Power Packs and Power Supplies shall be available that are WiFi enabled.
8. Power Packs (Secondary) shall be available that provide up to 16 Amp switching of all lighting load types.
9. Power Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
12. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
13. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
14. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
15. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
16. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.
17. Power (Relay) Packs and Supplies shall be the following nLight model numbers:
 - nPP16** (Power Pack w/ 16A relay)
 - nPP16 D** (Power Pack w/ 16A relay and 0-10VDC dimming output)
 - nPP16 WIFI** (Power Pack w/ 16A relay, WIFI enabled)
 - nEPP5 D** (Power Pack w/ 5A relay and 0-10VDC dimming output)
 - nSP16** (Secondary Pack w/ 16A relay)

LIGHTING CONTROLS

nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)
nPP16 D ER (UL924 Listed Secondary Pack w/ 16A relay and 0-10VDC dimming output for switching/dimming emergency power circuits)
nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)
nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)
nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)
nSP5 2P LVR (Louver/Damper Control Pack)
nSHADE (Pulse On/Off Control Pack)
nPP20 PL (Secondary Pack w/ 20A relay for general purpose receptacle load)
nPS 80 (Auxiliary Bus Power Supply)
nPS 80 WIFI (Auxiliary Bus Power Supply, WiFi enabled)
nAR 40 (Low voltage auxiliary relay pack)

E. Networked System Relay & Dimming Panels

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
8. Power (Relay) Packs and Supplies shall be the following nLight model numbers:
 - nPANEL 4** (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs)
 - nPANEL 2 480** (Panel w/ two dual phase relays (208/240/480 VAC) and two 0-10 VDC dimming outputs)

F. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.

LIGHTING CONTROLS

2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.
5. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
7. Specific I/O devices shall sense state of low voltage outdoor photocells.
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).
10. Auxiliary Input/Output Devices shall be the following nLight model numbers:
 - nIO D** (I/O device with 0-10 dimming output)
 - nIO 1S** or **nIO RLX** (I/O device with contact closure or 0-10VDC dimming input)
 - nIO NLI** (Input device for detecting state of low voltage outdoor photocell; sold in **nIO PC KIT** only)
 - nIO X** (Interface device for communicating with RS-232 enabled AV Touch Screens)

G. Networked LED Luminaires

1. Networked LED luminaire shall have a mechanically integrated control device
2. Networked LED luminaire shall have two RJ-45 ports available (via control device directly or incorporated RJ-45 splitter)
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
4. Networked LED luminaire shall provide low voltage power to other networked control devices (excluding EMG versions)
5. System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports "sleep mode"
6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
8. Integrated control devices shall be the following nLight model series:

LIGHTING CONTROLS

nIO LEDG (ER)
nIO EZ PH (ER)
nPS 80 EZ (ER)
nEPS 60 IO EZ
nEIO EZ LC (ER)

9. LED Luminaires shall be the following Acuity Brands LED fixtures, which come factory enabled with nLight devices:

Lithonia model families:

RTL(X)
TL(X)
VTL(X)
FSL(X)
ACL(X)
ALL(S)
AVL
BZL
GTL
SBS
IBL/IBH
PTN
LDN
DOM
WL
STL

Gotham model families:

EVO
Incito

Mark model families:

Slot 2/4/6
Fin
Veil
Whisper
NoI
SPR

Peerless model families:

Vellum
Mino
Round 2/4
Square

LIGHTING CONTROLS

Origami
Bruno
Staple
Lightline
Lightedge
Icetray
Cerra
Prima
Naro
Tulip
Envision
Aero
Enzo

H. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
3. All devices shall have two RJ-45 ports.
4. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
5. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
6. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
7. Devices with mechanical push-buttons shall be made available with custom button labeling
8. Devices with a single "on" button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
9. Wall switches & dimmers shall be the following nLight model numbers, with device options as specified:
 - nPODM** (single on/off, push-buttons, LED user feedback)
 - nPODM DX** (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
 - nPODM 2P** (dual on/off, push-buttons, LED user feedback)
 - nPODM 2P DX** (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
 - nPODM 4P** (quad on/off, push-buttons, LED user feedback)
 - nPODM 4P DX** (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

LIGHTING CONTROLS

I. Networked System Graphic Wall Station

1. Device shall have a 3.5" full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
4. Device shall enable user supplied .jpg screen saver image to be uploaded.
5. Device shall surface mount to single-gang switch box.
6. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
7. Device shall have a micro-USB style connector for local computer connectivity.
8. Device shall have two RJ-45 ports for communication
9. Device shall be the following nLight model number:

nPOD GFX

J. Networked System Scene Controllers

1. Device shall have two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
3. Device shall recess into single-gang switch box and fit a standard GFI opening.
4. Devices shall provide LED user feedback.
5. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
6. All devices shall have two RJ-45 ports.
7. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
8. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
9. Device shall have LEDs indicating current selection.
10. Scene Selector device shall be the following nLight model number:

nPODM 2S (2 Scene, push-button)

nPODM 4S (4 Scene, push-button)

nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower)

nPODM 2L (2 Adjustable Preset Levels, push-button, On/Off)

nPODM 2L AB (2 Scene, push-button, On/Off/High/Low)

nPODM 4L DX (4 Adjustable Preset Levels, push-button, On/Off/Raise/Lower)

K. Communication Bridges

LIGHTING CONTROLS

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
6. Communication Bridge devices shall be the following nLight model numbers:
nBRG 8 (8 Ports)

2.4. LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- D. Specific device parameters (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device, with a system backup on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5. MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.6. BMS COMPATIBILITY

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software.
- B. BACnet IP connection shall also be available utilizing JACE-600 hardware unit.
- C. BACnet IP hardware shall be capable of supporting up to 1500 total devices across up to 5 total Gateways
- D. BACnet IP connection shall communicate information gathered by networked system to other building management systems.
- E. BACnet IP connection shall translate and forward lighting relay and other select control commands from BMS system to networked control devices via profiles stored in the system Gateway. All system devices shall be available for polling for devices status.
- F. BACnet IP hardware device shall be the following nLight model name:

nBACnet

2.7. SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.

- C. An “Energy Scorecard” shall be display that shows calculated energy savings in dollars, KWHr, or CO2.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.
- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

2.8. START-UP & SUPPORT FEATURES

- A. Pre-construction Jobsite Visit
 - a. Project electrical contractor/distributor shall contact Spectrum Lighting – San Antonio to schedule jobsite meeting prior to the beginning of the installation of the lighting control system. Purpose of the meeting is to review installation documentation provided by the system manufacturer and submittals. Discussion should include wiring conventions and specific wiring requirements. Installation of specific devices are also to be addressed.
 - b. Purpose is to review any questions regarding the installation of the lighting control system by the installing contractor.
 - c. Prior to commissioning Spectrum Lighting field service technical shall visit the jobsite to confirm progress and answer any additional questions. Commissioning date is to be confirmed at the time of this visit. Training agenda shall be provided to the contractor/distributor. Contractor/distributor shall confirm owner representative and specifying engineer attendance at lighting system demonstration and/or for training. Contractor/distributor shall provide to filed service technician programming information as required for commissioning to include zone assignments, time schedules for operation, presets for all control stations, programming sequences for dynamic LED fixtures, emergency operation, blink warn, and system override. Programming information is required for system set-up and pre-commissioning.
- B. Lighting Control System Commissioning and Training
 - a. Prior to energizing the lighting control system, the following must be completed: No component of the lighting control system shall be energized prior to a factory certified field service engineer has approved the installation of the system by the project electrical contractor. Failure to have a factory certified field service technician approve the installation and commission the system will relieve the manufacturer of the lighting control equipment of all responsibility relating to

LIGHTING CONTROLS

damaged parts or warranty. The electrical contractor/distributor shall contact Spectrum Lighting at least 3 weeks prior to the requested commissioning date to schedule a field service engineer to be at the jobsite. Request shall be in writing and shall include filled out commissioning request form and dated jobsite photos of the dimmer and/or relay panels.

- b. Lighting Control system is defined as the dimmer/relay panel(s) and all associated control stations and related accessories.
- c. The electrical contractor is responsible to install the entire lighting control system, all power feeders, all load wiring, and control wiring. Equipment shall be installed according to the manufacturer's instructions, contract documents, and national and local codes and regulations.
- d. Equipment shall be plumb and level to the finished floor. All components of the lighting control system shall be clean, free of dust and paint spatters. Components shall be unmarred or damaged. All cable shall be dressed, neatly routed, and labeled. All conduit shall be securely attached to the dimmer/relay panel.

C. Commissioning

- a. Each dimmer/relay panels shall be individually tested with the connected load as designed. Each dimmer/relay should be tested with its connected load as specified.
- b. Each dimmer/relay shall be tested by the electrical contractor (with a multi-meter) to confirm what voltage is being passed and to confirm that no voltage is being passed when the circuit is open.
- c. A representative of the owner shall be present to observe the testing/demonstration of the dimmer/relay panels. Each individual dimmer/relay panel shall be load tested with all circuits on while under load for a minimum of 1 hour.
- d. Where external devices are to be attached to the dimmer/relay panel including photocell, occupancy sensor, time clock, and/or control stations, operation of each device should be verified at the panel and specific circuits that are programmed to be controlled by the external device(s).
- e. Where control signals originate from the dimmer/relay panel for control of lighting fixtures, the control signal shall be tested by the electrical contractor to confirm that it is being delivered to each lighting fixture. Proper operation of the lighting fixtures shall be confirmed as part of the system testing/demonstration.

D. Training

- a. Training shall be provided for the owner's representative and contractor FOR A TOTAL OF 8-HOURS. Prior to commissioning owner's representative and electrical contractor/distributor shall acknowledge receipt of training agenda. Electrical contractor/distributor shall confirm that specifying engineer has been contacted and been invited to attend the system demonstration and/or training. All product and lighting control system documentation and operation's manuals shall be provided by electrical contractor/distributor at the time of training.

LIGHTING CONTROLS

- b. Training is to include, but not be limited to: basic operation of lighting control system, set-up of system and control panels, operation of control stations, programming of system, basic be-bugging, and overall system testing. At completion of training session all in attendance shall sign the commissioning technician's field service report to confirm participation in the training session.
 - c. Completed field service report shall be submitted to the electrical contractor/distributor and specifying engineer.
- E. Follow-up Contact
 - a. Approximately 90 days following the commissioning of the lighting control system Spectrum Lighting shall contact the electrical contractor/distributor to confirm that the system is operating correctly and answer any operational questions that have come-up since commissioning.
- F. Warranty Review and Follow-up Visit
 - a. Approximately 300 days following commissioning of the lighting control system Spectrum Lighting shall contact the owner's representative who attended the system demonstration and training and electrical contractor/distributor to schedule a visit to the jobsite. Visit shall be scheduled so that testing of the lighting control system and related equipment can be conducted without disturbing normal operation of the jobsite. In attendance should be owner's representative and contractor.
 - b. The lighting control system shall be demonstrated to confirm operation. All system programming shall be confirmed and when necessary adjusted to meet the set-up or current requirements. When programming needs to be adjusted the new system configuration files shall be forwarded by the field service technician to the system manufacturer, as required. Copies can be provided to owner's representative upon request. Any questions regarding operation of the system shall be addressed at this time.
 - c. Any lighting control equipment that is not operating as defined by the specification shall be repaired or replaced at the discretion of the field service technician. Projected dates for completion of all changes will be included in the follow-up report. All system changes and updates shall be documented by the field service technician and provided in a written report to the owner's representative, contractor, and specifying engineer.
 - d. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
 - e. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
 - f. Once software is installed, system shall be able to auto-discover all system devices without requiring any further programming.
 - g. All system devices shall be capable of being given user defined names.

- h. All devices within the network shall be able to have their firmware upgraded remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- i. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Edit panelboards below to suit Project.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Distribution panelboards.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Retain subparagraph below if Project includes fusible panelboards.
 - 3. Section "Fuses."

1.3 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. RFI: Radio-frequency interference.
- E. RMS: Root mean square.
- F. SPDT: Single pole, double throw.
- G. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Delete subparagraph below if series rating of overcurrent protective devices is not used.
 - e. UL listing for series rating of installed devices.

f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Delete paragraph below if independent testing agency is not used.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in other sections. In addition to requirements specified in Section "Contract Closeout," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency.

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. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Edit below to delete or add types of equipment that affect panelboard installation.

B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

A. Extra materials may not be allowed for publicly funded projects. Revise quantity below to suit Project.

B. Keys: [SIX] 6 spares of each type of panelboard cabinet lock.

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:

B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lists below are examples only. Retain or insert only those manufacturers whose products correspond with other requirements and whose availability and suitability for the application have been verified.

2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton

b. Square D Co.

c. General Electric

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Delete items below if not applicable. Add other Project-specific requirements.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 4. Enclosures in hazardous locations must be carefully selected to meet the division and group listing of the environment.
 - 5. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Retain paragraph above or below.
- D. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- E. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- F. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- G. Bus: Hard-drawn copper, 98 percent conductivity.
- H. Main and Neutral Lugs: Copper mechanical type suitable for use with conductor material.
- I. Ten paragraphs below are special features. Add other required features and coordinate with Drawings.
- J. Equipment Ground Bus: Copper and adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- K. Delete paragraph below except for panelboards incorporating one or more main service disconnect switches. Edit to suit Project.
- L. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- M. Delete paragraph below if future provisions are not required.
- N. Isolated Equipment Ground Bus: Copper and adequate for branch-circuit equipment ground conductors; insulated from box.
- O. Extra-Capacity Neutral Bus: Copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- P. Split Bus: Vertical buses divided into individual vertical sections.
- Q. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- R. Gutter Barrier: Arrange to isolate individual panel sections.
- S. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- T. Feed-through Lugs: Copper mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Select one of two paragraphs below for series-rated system or system that has panelboards and circuit breakers rated for full value of short-circuit current available at location of equipment. Edit to suit Project and coordinate with Drawings.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in or bolt on circuit breakers, replaceable without disturbing adjacent units.
- B. Coordinate below with Drawings.
- C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

- A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with Drawings.
- B. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- C. Main Overcurrent Protective Devices: Circuit breaker.
- D. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with schedules and Drawings.
- B. Molded-Case Circuit Breaker: NEMA AB 1, 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. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 - 5. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.

- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Revise paragraph below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Revise below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Select Division 16 Section "Basic Electrical Materials and Methods" for projects with simple requirements and Division 16 Section "Electrical Identification" for projects with complex requirements.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods" [Electrical Identification].
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Coordinate paragraphs below with Drawings.
- B. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- C. 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.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited for Project.
- B. GFI: Ground-fault circuit interrupter.
- C. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Include sample review below if products may have critical features needing hands-on appraisal.
- D. Samples: For devices and device plates for color selection and evaluation of technical features.
- E. Maintenance Data: For materials and products to include in maintenance manuals specified in other sections.

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.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Delete paragraph below unless receptacles for Owner-Furnished equipment with plugs have unknown configurations.
- B. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- C. Coordinate with pool contractor for special receptacles.

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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. GE Company; GE Wiring Devices.
 - d. Hubbell, Inc.; Wiring Devices Div.
 - e. Killark Electric Manufacturing Co.
 - f. Leviton Manufacturing Co., Inc.
 - g. Pass & Seymour/Legrand; Wiring Devices Div.
 - h. Pyle-National, Inc.; an Amphenol Co.

2.2 RECEPTACLES

- A. Select one of three paragraphs below to specify grade of receptacles. See Editing Instruction No. 3 in the Evaluations for wiring device grades.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade. The device shall be 20-ampere, 125-volts, Nema configuration 5-20R, back and side wired.
- C. Special Receptacles for NEMA configuration refer to Manufacturer specs.
- D. Termination-type GFCI unit may be substituted for feed-through type where no protection of downstream receptacles is required.
- E. GFI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter. Device shall have an indicator light.
- F. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap. Device shall be white finish with the orange symbol.
 - 2. Devices: Listed and labeled as isolated-ground receptacles.
 - 3. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

2.3 SWITCHES

- A. General
 - 1. Switches shall be toggle rocker type as indicated herein.. The body of the switch shall be made of an arc-resistant thermoset material. All toggle switch handles shall be constructed of a thermoplastic material. All rocker switch handles shall be constructed of a thermoset material. All wall switches shall be of the quiet AC type.
 - 2. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
 - 3. Switch color shall be white unless noted otherwise. Coordinate with Architect.
- B. Specification Grade
 - 1. Specification Grade switches shall be toggle type. The contact arms shall be made of one-piece copper alloy material. The switch shall include a green ground screw attached to the mounting strap. The switch shall be 20-ampere, 120/277-volts AC, horsepower rated, back and side-wired.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
 - 1. Modify subparagraph below to suit preference.
 - 2. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
 - 3. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide with "on/off" switch; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads. Dimmer to be sized per circuit load.

2.4 WALL PLATES(All wall plates)

- A. For all single and combination types match corresponding wiring devices.
 - 4. Plate-Securing Screws: Metal with head color to match plate finish.
 - 5. Select one of five subparagraphs below. Coordinate with Division 9 Section "Painting."
 - 6. Material for Finished Spaces: 0.04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.
 - 7. Select one of three subparagraphs below or delete all.
 - 8. Material for Unfinished Spaces: stainless steel.

2.5 FLOOR SERVICE FITTINGS

- A. Items in this Article are available for telephone and data cable service as well as power. Edit to suit Project.
- B. Select one of three paragraphs below.
- C. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

- D. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Coordinate two paragraphs below with Drawings.
- F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- G. Protect devices and assemblies during painting.
- H. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
- I.

3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."
- B. Select paragraph above or below.
- C. Comply with Section "Basic Electrical Materials and Methods."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Select paragraph above or below. Coordinate with Division 16 Section "Grounding."
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Dparagraph below if GFCIs are not in Part 2.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fuses.

1.3 SUBMITTALS

- A. Use this Article to convey basic design intent. Delete if Drawings show sufficient detail to clarify intent.
- B. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.
- C. Product Data for each fuse type specified.
- D. Select above or below. Data listed in paragraph below are appropriate where selective coordination is necessary.
- E. Field test reports indicating and interpreting test results.
- F. Maintenance data for tripping devices to include in the operation and maintenance manual specified in other sections.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Subparagraph below is required by some Federal agencies.
 - 3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

- A. Extra materials may not be allowed for publicly funded projects.
- B. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:

- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
 - C. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
 - 2. Cooper Industries, Inc.; Bussmann Div.
 - 3. Eagle Electric Mfg. Co., Inc.
 - 4. Ferraz Corp.
 - 5. General Electric Co.; Wiring Devices Div.
 - 6. Gould Shawmut.
 - 7. Tracor, Inc.; Littelfuse, Inc. Subsidiary.
- 2.2 CARTRIDGE FUSES
- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.
- 2.3 SPARE FUSE CABINET
- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.
 - 1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.
 - 4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
 - B. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 FUSE APPLICATIONS
- A. Select and edit paragraphs below. Add paragraphs as Project requires to specify fuse applications rather than show them on Drawings.
 - B. Motor Branch Circuits: Class RK1, time delay.
 - C. Other Branch Circuits: Class RK5, non-time delay.
- 3.3 INSTALLATION
- A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.
 - B. Install spare fuse cabinet where indicated.
- 3.4 IDENTIFICATION
- A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of disconnect switches, including all related systems and accessories.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 - PRODUCTS.
- B. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.
- C. Provide designations for each disconnect. RE: to section 16075.

1.4 REFERENCE STANDARDS

- A. Switches shall be manufactured in accordance with the following standards:
 - 1. UL 98 - Enclosed and Dead Front Switches
 - 2. NEMA KS1 - Enclosed Switches
 - 3. NEMA 250 - Enclosures for Electrical Equipment

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Eaton
- B. Square D Co.
- C. General Electric

2.2 GENERAL

- A. Switches shall be heavy duty type.

2.3 SWITCH INTERIOR

- A. Switches shall have switch blades which are visible when the switch is OFF and the cover is open.
- D. Lugs shall be copper and front removable and UL listed for 60°C or 75°C conductors 30-100 ampere, 75°C conductors 200 ampere and up.
- E. Current carrying parts shall be plated to resist corrosion.
- F. Switches shall have removable arc suppressor to facilitate easy access to line side lugs.
- G. Switches shall have provisions for a field installable electrical interlock.

2.4 SWITCH MECHANISM

- A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
- B. The operating handle shall be an integral part of the box, not the cover.

- C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
- D. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.
- E. Switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.5 SWITCH ENCLOSURES

- A. Switch covers shall be attached with welded pin-type hinges (Type 1) or top-hinged, attached with removable screws and securable in the open position (Type 3R).
- B. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1) or gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel (Type 3R).
- C. The enclosure shall have ON and OFF markings stamped into the cover.
- D. The operating handle shall be provided with a dual colored, red/black position indication.
- E. Switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.
- H. Tangential knockouts shall be provided to facilitate ease of conduit entry (Type 1).
- I. Type 3R enclosure shall contain no knockouts. Supply watertight hubs.
- J. Type 4x shall be stainless steel enclosure with no knockouts. Supply watertight hubs.

2.6 SWITCH RATINGS

- A. Switches shall be horsepower rated.
- B. The UL listed short circuit current rating of the switches shall be: 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses 30-600 ampere employing appropriate fuse rejection schemes.

PART 3- EXECUTION

3.1 INSTALLATION

- D. Install disconnect switches where indicated shown or not shown.
- E. Install fuses in fusible disconnect switches.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, apply to work covered by this Section.
- B. Comply with Electrical Sections, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a high-energy power conditioning surge protection device(s) at branch circuit panelboards where indicated on the Drawings. The device shall incorporate transient voltage surge suppression (TVSS) and high-frequency electrical line noise filtering. The device shall provide effective high energy transient voltage suppression, surge current diversion, high-frequency attenuation, and line stabilization in ANSI/IEEE C62.41-2002 environments connected downstream from the facility's main overcurrent protective device. The device shall be connected in parallel with the facility's wiring system.
- B. The device shall be installed as an integral part or external of the panelboard, switchboard.

1.3 SUBMITTALS

- A. Submit product data and shop drawings for products specified under PART 2 - PRODUCTS.
- B. Manufacturers' Product Data: Submit material specifications and installation data for products specified under PART 2 - PRODUCTS.
- C.
- D. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.
 - 1 Include electrical characteristics and ratings for the specified equipment.
 - 2 Include wiring diagrams indicating the internal connections of the specified equipment within its enclosure.
 - 3 Drawings shall be provided indicating device dimensions, weights, mounting provisions, connection details and wiring diagrams.
 - 4 Documentation of the specified device UL 1449 3rd Edition voltage protection rating (VPR) and per mode surge current rating shall be included. All submittals without this documentation will be rejected.
 - 5 The manufacturer shall make available upon request certified documentation of applicable Location Category Testing in full compliance with ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1987 Guidelines.
- E. Record Drawings
 - 1 A complete set of manufacturers' product data and shop drawings indicating all post bid revisions and field changes.

1.4 QUALITY ASSURANCE

- A. Industry Reference Standards and Publications: The device shall be designed, manufactured, tested and installed in compliance with the latest editions of:
 - 1 American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-2002 and C62.45-2002)
 - 2 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
 - 3 National Electrical Manufacturers Association (NEMA LS-1)
 - 4 National Fire Protection Association (NFPA 70, National Electrical Code (NEC), 75 and 78)

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

- 5 Underwriters Laboratories UL 1449 Standard for Transient Voltage Surge Suppressors Surge Protection Devices and UL 1283 Standard for Electromagnetic Interference Filters.
- B. The device shall be UL listed under UL 1449 and UL 1283 complimentary listed.
- C. The device shall be warranted against defects in material and/or workmanship and any failure or end-of-life event including lighting for a minimum of TEN (10) years from the date of shipment.
- D.
- E. The device shall be thoroughly factory-tested before shipment. Testing of the device shall include but not be limited to quality control checks, maximum continuous operating voltage (MCOV) check, and clamping voltage verification tests. The MCOV check shall consist of a minimum of one (1) hour burn-in at the applicable MCOV.
- F.

1.5 SYSTEM DESCRIPTION

A. Environmental Requirements

- 1 Storage Temperature: Storage temperature range shall be -40° to +85° C (-40° to +185° F).
- 2 Operating Temperature: Operating temperature range shall be -40° to +60° C (-40° to 140° F).
- 3 Relative Humidity: Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
- 4 Operating Altitude: The device shall be capable of operation in an altitude of 0 - 12,000 feet above sea level.
- 5 Audible Noise: The device shall not generate any audible noise.
- 6 Magnetic Fields: No appreciable magnetic fields shall be generated. The device shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
- 7 Electrical Requirements
- 8 Device Operating Voltage: The nominal operating voltage and configuration shall be that of the switchgear, distribution panel, sub or branch panelboard. Maximum Continuous Operating Voltage (MCOV): The allowable maximum continuous operating voltage of all suppression components utilized in the unit shall not be less than 115% of the nominal operating voltage.
- 9 Operating Frequency: The operating frequency range of the device shall be 47 to 63 Hertz.

10 Protection Modes: The devices primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.

11 Surge Current Capacity and Voltage Protection Rating: Unless specifically noted on the drawings and/or the schedules, the surge current capacity, and the voltage protection rating of the SPD shall be not less than listed on the following table.

The above text gives you the option to request a specific surge current rating on the riser or panel schedules

5. Construction: SPD's with a surge current rating of greater than 155,000 amps per mode shall be field serviceable modular devices. SPD's with a surge current rating of less than 155,000 amps may be non-modular.

Location	Per Mode Surge Current Rating	120/208vac 3 phase VPR	277/480vac 3 phase VPR
Switchgear	200,000 amps	900v	1200v
Distribution Panel	150,000 amps	900v	1200v
Sub or Branch Panel	100,000 amps	900v	1200v

1.6 DOCUMENTATION

- A. Equipment Manual. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the system.

PART 2 - PRODUCTS

3.1 MANUFACTURER

- 1 Square D
- 2 Cutler-Hammer

3 Current Technology
4 THOR SYSTEMS

3.2 TRANSIENT VOLTAGE SURGE SUPPRESSION COMPONENTS

- A. The device shall include a solid-state suppression system which includes arrays of fused non-linear voltage dependent metal oxide varistors (MOV's) with similar operating characteristics. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate any other components which may degrade performance or reliability of the

3.3 HIGH-FREQUENCY FILTER

- A. The device shall include a UL 1283 high frequency extended range tracking filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise eliminating disturbances which may lead to system upset. The filter shall provide minimum insertion loss of 45 dB at 100 kHz attenuation frequency utilizing the MIL-STD-E220A 50 ohm insertion loss methodology.

3.4 INTERNAL CONNECTIONS

- a. All internal wiring associated with the suppression/filter device and subject to surge currents shall utilize low-impedance copper bus bar and/or #4 AWG copper conductor or larger. All internal connections associated with the suppression/filter device and subject to surge currents shall be made with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance.

3.5 FIELD CONNECTIONS

- A. The device shall include mechanical lugs for each phase, neutral and ground, or permanently connected conductors as applicable. The lugs shall accommodate up to #4 AWG copper conductor.

3.6 ENCLOSURE

- A. The device shall be provided in a surface mounted NEMA 1 type hinged enclosure, with a NEMA rating that matches or exceeds that of the switchgear, distribution panel, sub or branch panelboard that is being protected. of minimum 14 gauge steel, painted inside and out. Enclosure width shall not be greater than 24 inches.

3.7 MONITORING

- a. The device shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit.
- b. Dry Contacts
- c. Audible alarm with silence switch
- d. For Service Entrance or Switchgear SPD's: LED visual status indicators, Audible alarm with silence switch, Dry Contacts plus Surge Event Counter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation, operation and maintenance instructions, and all national and local codes.
- B. The device shall be installed as close as practical to the facility's wiring system in accordance with NEC Article 285, IEEE 1100-2005 section 8.4.2.5, plus applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be from a minimum 40A branch circuit breaker in the switchgear, distribution panel or panelboard with #4 AWG copper conductors not any longer than necessary, avoiding unnecessary bends. Advise the engineer if the installed In no case

shall conductors will be longer than 3 feet in length. Verify circuit breaker size with manufacturer.

3.2 TESTING

- A. The system shall be field tested in the presence of the Owner. At the same time operational procedures shall be reviewed with the Owner.
- B. If external test equipment is required, two (2) testers shall be furnished to the owner and two (2) training sessions shall be furnished. The first training session shall be with 90 days of occupancy and the second training session shall be not less eight months, but not more than 12 months after the first training session. Training and test equipment shall be furnished at no additional cost to the owner.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, emergency lighting units, and accessories.
- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 4. Emergency lighting unit battery and charger.
 - 5. LED lights
 - 6. Retain two subparagraphs below for projects with air-handling fixtures.
 - 7. Types of lamps.
- B. Delete paragraph and subparagraph below unless custom fixtures are indicated.
- C. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- D. Consider retaining paragraph below for projects with congested ceiling space and where Drawings do not include comprehensive reflected ceiling plans.
- E. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.
- F. Retain paragraph and subparagraphs below if fixture Samples are required for verification purposes. Edit if sample requirements are indicated in other than interior lighting fixture schedule. As an alternative, list of fixture types for sample submission can be added below.
- G. Delete paragraph below if not required.
- H. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- I. Delete paragraph below except for projects with extensive tests of emergency lighting equipment.
- J. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

- K. Maintenance Data: For lighting fixtures to include in maintenance manuals in the close out documents.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. Delete paragraph below if FM compliance is not required. Coordinate with Drawings.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Retain this Article if Coordination Drawings are not required.
- B. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

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.

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 products indicated in the Interior Lighting Fixture Schedule at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support 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.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED FIXTURES

- A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.

B. Include the following features unless otherwise indicated:

1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
4. Color Rendering Index (CRI) of 82 at a minimum.
5. Color temperature [3500] <Insert value> K, unless otherwise indicated.
6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
7. Fixture efficacy of 60 Lumens/Watt, minimum.
8. 5 year luminaire warranty, minimum.
9. Photometry must comply with IESNA LM-79.
10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.

C. Technical Requirements

1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

D. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.4 LED EXIT SIGNS

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.

- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
 - 1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
 - 2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 - 3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
- G. Voltage: Multi-voltage (120 – 277V).

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
 - 1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.6 LAMPS

- A. ALL LED – NO LAMPS

2.7 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. NFPA 70 requires minimum support for fixtures. Retain paragraphs below for more specific support requirements and for requirements exceeding code minimums. Units in seismic zones must have additional supports and restraining devices beyond those specified here. See Editing Instruction No. 3 in the Evaluations.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid for support.
 - 1. Install a minimum of two ceiling support system wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
 - 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.

3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

D. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3.2 CONNECTIONS

A. Ground equipment.

1. 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. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: As follows:

1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to battery source and retransfer to normal.
4. Report results in writing.

E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

F. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior lighting units with luminaires and lamps.
- B. Related Sections include the following:
 - 1. Section "Interior Lighting" for interior fixtures, lamps, ballasts, emergency lighting units, and accessories; and for exterior luminaires normally mounted on buildings.

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaires.
 - 2. Delete "independent" in subparagraph below if certified tests by manufacturer are adequate.
 - 3. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 4. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
 - 5. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 6. High-intensity-discharge luminaire ballasts.
- B. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements.
- C. Delete paragraph below except for projects with extensive tests of installations.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For lighting units to include in maintenance manuals specified in other sections.

1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by acceptable to authorities having jurisdiction
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 WARRANTY

- A. General Warranty: LED fixture warranty is a five year limited warranty. Pole standard warranty is one year.

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 products indicated in the Exterior Lighting Unit Schedule at the end of Part 3.
- B. Retain above for nonproprietary or below for semiproprietary Specification, and name products in schedules or details.
- C. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 LUMINAIRES

- A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. 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 to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Photoelectric Relays: As follows:
 - 1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
 - 2. Relay Mounting: In luminaire housing.
- K. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).

2. Correlated Color Temperature (CCT): 4000K
3. Color Rendering Index (CRI): ≥ 85 .
4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating

LED DRIVERS

- A. LED drivers shall meet the following requirements:
 1. Drivers shall have a minimum efficiency of 85%.
 2. Starting Temperature: -40 degrees C (-40 degrees F).
 3. Input Voltage: 120 to 480 ($\pm 10\%$) volt.
 4. Power Supplies: Class I or II output.
 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 6. Power Factor (PF): ≥ 0.90 .
 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.//

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Ground equipment.
 1. 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.
- B. Ground metal poles/support structures according to Section "Grounding and Bonding."
 1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:

3.3 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.

END OF SECTION

SECTION 27 05 33

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions apply to work covered by this Section.
- B. Comply with Sections 26 00 00, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a telephone and data communications empty conduit system, including all related systems and accessories.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with the Architectural sections.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduit, conduit sleeves, outlet boxes, cover plates and pullwire as indicated.
- B. Fireproofing material for telephone and data communication conduit and conduit sleeves through fire rated walls and floors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install telephone and data communication raceways as indicated.
- B. Install individual raceways from telephone and data communications outlets to above accessible ceiling. In areas without a ceiling, raceways shall be routed to the nearest ceiling space. In building without a ceiling, raceways shall be extended back to the main telephone/ data communication board or to a location indicated on the Drawings.
 - 1 Minimum size conduit: 1.25 inch, REFER TO PLANS FOR SIZES.
 - 2 Raceway installation shall be in accordance with Section 26 05 33.
 - 3 Coordinate raceway installations in millwork and other fabricated architectural items with the other portions of the Work.
 - 4 Provide pullwire in each raceway tagged on each end.
 - 5 Raceways shall be terminated with an insulating bushing or a suitable connector with an insulated throat.
- C. Provide telephone and data communications outlet boxes.
 - 6 Provide a one-gang outlet unless noted otherwise.
 - 7 Install outlet box and device ring at each location.
 - 8 Install telephone and data communications outlets at same height specified for convenience outlets unless noted otherwise. Group telephone and data communications outlets with related receptacle outlets unless noted otherwise.
 - 9 Install a blank cover plate on all unused communications outlet boxes.

END OF SECTION

SECTION 27 10 00 STRUCTURED CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section identifies the requirements, technical design, and specifications for the structured cabling system for the Laredo College Veterans Center, located in Laredo, Texas ("Owner"). The structured cabling system as specified is an Industry-Standard Category 6 and 6A structured cabling system and includes backbone cabling, horizontal cabling and equipment room hardware as specified.
- B. The Contractor shall provide a minimum Manufacturer's 20-Year Performance Certification for the installed structured cabling system, certified by Berk-Tek/Leviton for copper and Corning Optical Communications for fiber.
- C. Contractor shall include materials, equipment, and labor necessary to provide a complete and functional structured cabling system regardless of any items not listed or described in this specification or associated drawings.

1.2 REQUIREMENTS TABLE OF CONTENT

- A. Contractor Experience Requirements
- B. Submittal Requirements
- C. Acceptable Manufacturers
- D. Codes, Standards and Regulations
- E. General Requirements
- F. System Requirements
- G. Testing Requirements
- H. Project Closeout Documentation
- I. Attachments

1.3 RELATED REQUIREMENTS

- A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 27, and shall be complied with in every respect. The Contractor shall examine all of the items which make up the Contract Documents, and shall coordinate them with the work on the project.
- B. Contractor Experience Requirements
 - 1. The Contractor shall be a Certified Berk-Tek/Leviton Installer prior to submitting a bid for the work.
 - 2. The Contractor shall possess all relevant Manufacturer Certifications (i.e. structured cable systems, testing equipment, etc.) for both the company and individual technicians prior to submitting a bid for the work.
 - 3. The Contractor's Project Manager shall be a Registered Communications Distribution Designer (RCDD) and available for all on-site coordination meetings.
 - 4. The Contractor shall have been in business for a minimum of five (5) years.

5. The Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 100-mile radius of the project site.
 6. The Contractor shall have completed a minimum of three (3) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- C. Subcontractors shall be identified at the time of bid and comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.4 SUBMITTAL REQUIREMENTS

A. Pre-Installation Submittal

1. Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the Architect/Design Consultant.
2. Contractor shall ensure submittals are submitted in a timely manner to ensure all products can be ordered and received on site in order to not cause any delays. If there are any concerns with any products having long lead times, those products shall be clearly identified in writing so the review and approval can be expedited.
3. All submittals shall be submitted in the same sequence as they are listed in the specifications (i.e. product data in the sequence items are listed in the product data section, manufacturer product certifications for company, manufacturer product certifications for installers, etc.). Submittals not in the proper sequence will not be approved.
4. Manufacturer product data sheets for each proposed system component.
 - a. For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted. Product data sheets without the part number clearly identified will not be approved.
5. Manufacturer Product Certifications for Company.
6. Manufacturer Product Certifications for Installers.
7. Manufacturer Certifications for testing equipment technicians.
8. Manufacturer Certifications for testing equipment calibration.
9. RCDD Certificate for Contractor's Project Manager.
10. Manufacturer Warranty letter.
11. Documentation indicating that Contractor has been in business for (3) years.
12. Address of Contractor's local office within a 100-mile radius of the project site.
13. Quantity of full time local technicians within a 100-mile radius of the project site.
14. List of three (3) contractor-installed projects of a similar size and scope that have been in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
15. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
16. List of subcontractors performing any work on the project. List shall clearly identify the subcontractor's legal name and address, the scope of work to be performed by the subcontractors and the overall percentage of the project being provided by the subcontractor. If there are no subcontractors performing any work on the project, submit a statement on company letterhead clearly indicating no subcontractors will be performing any work on this project.
17. Contractor shall maintain a set of shop drawings on site at all times and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the Architect/Design Consultant.

18. Contractor shall submit a line, by line specification review acknowledging conformance to the contract documents. If any variances are taken due to a product being discontinued or factory recommended replacement for product reaching end of life the contractor shall note it on the review as a variance. The specified products will be itemized and listed as an attachment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The following sections specifically list the acceptable equipment types and items for this project.
- B. Architect/Design Consultant will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- C. Proposed equivalent items must be approved in writing by the Architect/Design Consultant prior to purchase or installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- D. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall substitute the appropriate equivalent manufacturer's part number and add the required information to the submittal package.
- E. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished.
- F. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- G. All wiring, equipment, and installation materials shall be new and of the highest quality.
- H. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.
- I. Original Equipment Manufacturer (OEM) documentation must be provided to the Architect/Design Consultant which certifies performance characteristics and compliance with ANSI/TIA 568-D standards.
- J. Contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. Contractor shall clearly identify any concerns with lead times in writing to the Architect/Design Consultant prior to submitting a proposal for this work. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues and the Contractor will have all products on-site when needed to complete the job as required.

2.2 FIBER OPTIC BACKBONE CABLE

- A. Indoor/Outdoor
 1. Single-Mode Indoor/Outdoor Plenum Rated 24 Strand – Corning Optical Communications 024EWP-T4101DA3

2. Multi-Mode Indoor/Outdoor Plenum Rated 24 Strand – Corning Optical Communications 024TWP-T4190DA3

2.3 HORIZONTAL CABLE

A. Category 6A UTP Plenum

1. Network Access (Orange Sheath)
 - a. Berk-Tek Cat 6A - Part Number 10138767
2. Wireless Access (Orange Sheath)
 - a. Berk-Tek Cat 6A – Part Number 10138767
3. Interior Video Surveillance Cameras and Access Control Panels (Yellow Sheath)
 - a. Berk-Tek Cat 6A – Part Number 10137385
4. Network Access Outside Plant Rated (Black Sheath)
 - a. Berk-Tek cat 6A – Part Number 11094458

2.4 FIBER OPTIC CABLE TERMINATION

A. Fiber Enclosure

1. Fiber Optic Enclosure –
 - a. 1RU – Corning CCH-01U

B. Multimode Fiber Pigtailed Splice Cassette

1. LC Duplex (12 fiber) Adapter Panel, Multimode, Aqua Adapters, Ceramic Alignment Sleeves – Corning CCH-CS12-A9-P00RE

C. Fiber Blank Plate

1. Blank Panel – Corning CCH

2.5 BACKBONE COPPER CABLE TERMINATION PANELS

A. Wall Mounted 110 Wiring Block

1. Panduit 100 Pair 110 Block with Legs – Part Number P110BW100-X

B. Building Entrance Protectors – for OSP Backbone Cabling

1. Building entrance terminal (BET) with 110-style input and output connectors
2. UL 497 Listed
3. Populated with 5 Pin Solid State Modules
4. Sized to match pair count of all OSP copper backbone cabling entering each Communications Room
5. Manufacturer:
 - a. Circa Indoor BET 110/110 Connector with 5-Pin Solid State Modules - 1880ENA1/NSC-## with 4B1FS-240
 - b. Or Approved Equivalent

2.6 CATEGORY 6A HORIZONTAL RACK MOUNTED PATCH PANELS

A. Network Access

1. Leviton 48 Port CAT 6A Patch Panel - Flat - Part Number 6A586-U48

B. Security Camera Access

1. Leviton 48 Port CAT 6A Patch Panel – Flat - Part Number 6A586-U48

C. Wireless Access

1. Leviton 48 Port CAT 6A Patch Panel – Flat - Part Number 6A586-U48

2.7 CATEGORY 6A MODULAR JACKS

A. Network Access

1. Leviton CAT 6A U/UTP – Part Number 6110G-RO6 (Orange)

B. Security Cameras and Access Control System / Intrusion Detection System

1. Cameras and Access Control: Leviton CAT 6A U/UTP – Part Number 6110G-RY6 (Yellow)

C. Wireless Access

1. Leviton CAT 6A – Part Number 6110G-RO6 (Orange)

D. Contractor shall provide and install Leviton Jacks in the appropriate colors to support the Patch Panel System.

2.8 CATEGORY 6A BUILDING ENTRANCE PROTECTORS

A. Category 6A Building Entrance Protector – Wall-Mounted

1. Solid state building entrance protector for Category 6 cables serving outlets on the exterior face and outside of the building
2. Approved per UL497 and UL497B
3. Shall support a minimum of 1G-BASE-T and Power-over-Ethernet applications
4. Manufacturer:
 - a. Ditek – DTK-VM6WM
 - b. Or equal from ITWLinx
 - c. Or Approved Equivalent

B. Category 6A Building Entrance Protector – Rack-Mounted

1. Solid state building entrance protector for Category 6 cables serving outlets on the exterior face and outside of the building
2. Approved per UL497 and UL497B
3. Shall support at least 1G-BASE-T and Power-over-Ethernet applications
4. Rack-mounted
5. RJ45 in and out
6. Manufacturer:
 - a. Ditek DTK-RM12ETHS
 - b. Or equal from ITWLinx
 - c. Or Approved Equivalent

C. Category 6A In-Line Surge Suppression – at Device end

1. Shielded surge protector
2. Approved per UL497B
3. Shall support at least 1G-BASE-T and Power-over-Ethernet applications
4. RJ45 in and out
5. Manufacturer:
 - a. Ditek – DTK-MRJEXTS
 - b. ITWLinx – CT6A-POE-RJ45
 - c. Or Approved Equivalent

2.9 TELECOMMUNICATIONS FACEPLATES

- A. With Designation Window – Coordinate color with Architect prior to ordering.
- B. 2-Port, 4 Port, and 6-Port Single Gang Flush (White)
 1. Leviton Single Gang Plastic Faceplate – Part Number 42080-2WS
 2. Leviton Single Gang Plastic Faceplate – Part Number 42080-4WS
 3. Leviton Single Gang Plastic Faceplate – Part Number 42080-6WS
- C. 2-Port Surface Mount Box (White)
 1. Leviton Surface Mount Biscuit – Part Number 41089-2WP
- D. Blank Insert (White)
 1. Leviton Blank Insert – Part Number 41084-BW
- E. Wall Phone Faceplate
 1. Stainless construction
 2. With mounting tabs to wall-mount telephone
 3. Manufacturer:
 - a. Leviton 4108W-1SP
- F. Decora-Style Mounting Frames
 1. Thermoplastic frame to install Category Jacks specified above into a standard decora-style opening, for use inside floor boxes and poke-thru's
 2. Manufacturer:
 - a. Leviton 41642-AW

2.10 PATCH CABLES

- A. Fiber Patch Cables
 1. Multimode Duplex Fiber Optic Patch Cords LC – LC
 - a. 1-Meter
 - b. Corning 797902QD120001M (confirm Cable Code, Polish Type, and Length with Owner prior to ordering)
- B. Copper Patch Cables
 1. Equipment Room / Telecommunications Rooms
 - a. Leviton CAT 6A Patch Cords – Part Number 6ASP0-3L (blue)
 - b. Leviton CAT 6A Patch Cords – Part Number 6ASP0-3L (blue)
 - c. * For Lengths 1 to 20 feet (increments of one foot)

- d. Contractor shall verify Patch Cord quantity and lengths shall be verified with the owner prior to purchase.
- 2. Workstations
 - a. Leviton CAT 6A U/UTP Patch Cords – Part Number 6ASP0-3L (blue)
 - b. Leviton CAT 6A U/UTP Patch Cords – Part Number 6ASP0-3L (blue)
 - c. * For Lengths 1 to 20 feet (increments of one foot)
 - d. Contractor shall verify Patch Cord quantity and lengths shall be verified with the owner prior to purchase.

2.11 EQUIPMENT RACKS, CABINETS, CABLE MANAGEMENT, AND ACCESSORIES

A. Two-Post Rack

- 1. Chatsworth – 55053-703
- 2. Or equal from Belden
- 3. Or equal from Commscope
- 4. Or equal from Hoffman
- 5. Or equal from Hubbell Premise
- 6. Or equal from Panduit
- 7. Or Approved Equivalent

B. Wall-mounted equipment cabinet

- 1. Fully enclosed cabinet, with locking front door and locking rear swing-out functionality.
- 2. Height: [12RU / 24-inches] [19RU / 36-inches] [26RU / 48-inches]
- 3. Depth: [18-inches] [24-inches] [30-inches]
- 4. Minimum weight capacity: 250 pounds
- 5. Steel construction for cabinet body
- 6. Front door: [solid metal] [tempered glass panel]
- 7. Equipped with the following accessories:
 - a. Fan Kit
 - b. Filter Kit
- 8. Manufacturer:
 - a. Chatsworth CUBE-iT – designer to insert part number
 - b. Or Approved Equivalent

C. Vertical Cable Managers

- 1. Provide 6-inch wide, dual-sided Vertical Cable Manager at both ends of a row of equipment racks in the MDF and each IDF.
- 2. Provide 8-inch wide, dual-sided Vertical Cable Managers between each equipment rack.
- 3. Shall have integral cover/door on both sides.
- 4. Manufacturer:
 - a. Chatsworth Evolution g2
 - 1) 6-inch wide: 35521-703 with floor bracket (35506-701)
 - 2) 8-inch wide: 35522-703 with Cable Divider Bar Kit (35503-701)
 - b. Or equal from 2-post rack manufacturer.

D. Horizontal Cable Managers (Black)

- 1. Chatsworth Rack Cabling Manager - Part Number 30530-719

E. Vertical Power Strip for 7' Equipment Rack

1. Provide one vertical power strip per 2-post and 4-post rack.
2. Chatsworth 24 Outlet (5-20R) Power Strip with Meter and NEMA 5-20P – Part Number 12848-755

2.12 CABLE RUNWAY (LADDER TYPE)

- A. Universal Cable Runway
 1. 18-inch Chatsworth - Part Number 10250-718
 2. Or approved equal from 2-post rack manufacturer
- B. Cable Runway Radius Drop, Cross Member
 1. 18-inch Chatsworth - Part Number 12100-718
 2. Or approved equal from 2-post rack manufacturer
- C. Cable Runway Radius Drop, Stringer
 1. Chatsworth - Part Number 12101-711
 2. Or approved equal from 2-post rack manufacturer
- D. Cable Runway Butt-Splice Kit
 1. Chatsworth - Part Number 11301-701
 2. Or approved equal from 2-post rack manufacturer
- E. Cable Runway Junction-Splice Kit
 1. Chatsworth - Part Number 11302-701
 2. Or approved equal from 2-post rack manufacturer
- F. Cable Runway Butt-Swivel Splice Kit
 1. Chatsworth - Part Number 10487-701
 2. Or approved equal from 2-post rack manufacturer
- G. Rack-to-Runway Mounting Kit
 1. 15 to 18-inch runway Chatsworth - Part Number 10595-718
 2. Or approved equal from 2-post rack manufacturer
- H. Cable Runway Elevation Kit for Racks
 1. Chatsworth - Part Number 10506-706
 2. Or approved equal from 2-post rack manufacturer
- I. Triangular Support Bracket, Aluminum
 1. 12 to 18-inch runway Chatsworth - Part Number 11312-718
 2. Or approved equal from 2-post rack manufacturer
- J. Wall Angle Support Kit, Cable Runway
 1. 18-inch runway Chatsworth - Part Number 11421-718
 2. Or approved equal from 2-post rack manufacturer
- K. 90 Degree Runway-Splice Kit
 1. Chatsworth - Part Number 11314-701
 2. Or approved equal from 2-post rack manufacturer

- L. 45 Degree Runway-Splice Kit
 - 1. Chatsworth - Part Number 11313-701
 - 2. Or approved equal from 2-post rack manufacturer
- M. Foot Kit, Cable Runway
 - 1. Chatsworth - Part Number 11309-701
 - 2. Or approved equal from 2-post rack manufacturer
- N. Vertical Wall Brackets (pair)
 - 1. Chatsworth - Part Number 10608-701
 - 2. Or approved equal from 2-post rack manufacturer
- O. Threaded Ceiling Kit, Cable Runway
 - 1. Chatsworth - Part Number 11310-001
 - 2. Or approved equal from 2-post rack manufacturer
- P. Threaded Rod Cover
 - 1. Chatsworth - Part Number 11085-001
 - 2. Or approved equal from 2-post rack manufacturer
- Q. Protective End Caps for Cable Runway
 - 1. Chatsworth - Part Number 10642-001
 - 2. Or approved equal from 2-post rack manufacturer
- R. End Closing Kit, Cable Runway
 - 1. Chatsworth - Part Number 11700-718
 - 2. Or approved equal from 2-post rack manufacturer

2.13 J-HOOKS / HOOK & LOOP STRAPS

- A. J-Hooks
 - 1. Shall be listed as meeting UL 2239 requirements
 - 2. Shall be listed/approved for installation in return-air plenum spaces
 - 3. Shall be designed and equipped with accessories (if needed) to be supported by the following methods:
 - a. Threaded rod from structure
 - b. Wall-mounted to concrete/CMU walls or wood or metal studs
 - c. Beam clamps
 - d. Optional "multi-tiered" mounting to bottom of J-hook
 - e. Optional Fastener to raised floor pedestal
 - 4. Equipped with retainer or strap over top of J-hook once cables are installed
 - 5. Sized to support quantity of installed cables, plus 25% spare capacity
 - 6. Manufacturer:
 - a. Erico – Caddy CAT Links
 - b. Panduit – J-Mod Cable Supports
 - c. Or Approved Equivalent
- B. Hook & Loop Straps

1. Plenum-rated
2. Velcro construction with hook/loop strap
3. Color: black
4. Manufacturer:
 - a. Panduit Tak-Ty Plenum Ties
 - b. VELCRO ONE-WRAP
 - c. Or Approved Equal

C. Grid Wire Clips

1. Caddy 6Z4S WR RD FLANGE CLIP
2. Or Approved Equal

2.14 TELECOM GROUNDING AND BONDING

A. TMGB (Telecommunications Main Grounding Busbar) / PBB (Primary Bonding Busbar)

1. Copper construction
2. Size: per Drawings
3. UL 467 Listed
4. TIA-607 hole pattern (pairs of lugs at 5/8" hole centers and 1" hole centers)
5. Part of kit that includes: busbar, two insulators, two steel stand-off brackets, and mounting accessories
6. Manufacturer:
 - a. 4" x 12" x 1/4"
 - 1) Chatsworth 40153-012
 - 2) Harger GBI14412TMGBKT
 - 3) Or equal from Hubbell
 - 4) Or equal from Panduit
 - 5) Or Approved Equal
 - b. 4" x 20" x 1/4"
 - 1) Chatsworth 40153-020
 - 2) Harger GBI14420TMGBKT
 - 3) Or equal from Hubbell
 - 4) Or equal from Panduit
 - 5) Or Approved Equal

B. TGB (Telecommunications Grounding Busbar) / SBB (Secondary Bonding Busbar)

1. Copper construction
2. Size: per Drawings
3. UL 467 Listed
4. TIA-607 hole pattern (pairs of lugs at 5/8" hole centers and 1" hole centers)
5. Part of kit that includes: busbar, two insulators, two steel stand-off brackets, and mounting accessories
6. Manufacturer:
 - a. 2" x 12" x 1/4"
 - 1) Chatsworth 13622-012
 - 2) Harger GBI14212TGBKT
 - 3) Or equal from Hubbell
 - 4) Or equal from Panduit
 - 5) Or Approved Equal

- b. 4" x 12" x 1/4"
 - 1) Chatsworth 40153-012
 - 2) Harger GBI14412TMGBKT
 - 3) Or equal from Hubbell
 - 4) Or equal from Panduit
 - 5) Or Approved Equal

C. Two-Hole Lugs

- 1. UL listed
- 2. Two-hole, long barrel, electro tin-plated compression lug with inspection port
- 3. Manufacturer:
 - a. Chatsworth 40162-XXX
 - b. Harger – GECLB series
 - c. Burndy
 - d. Or equal from Hubbell
 - e. Or Approved Equal

D. Conductors

- 1. Minimum conductor size shall be #6 AWG; sized based on length per Table on Drawings
- 2. Green sheath
- 3. Insulation shall be rated for the environment where it is installed
- 4. Manufacturer:
 - a. Chatsworth
 - b. Harger
 - c. Hubbell
 - d. Or Approved Equal
 - e. Or approved conductors listed in Division 26.

E. Conduit Clamps

- 1. Tinned copper with 1-1/2-inches of contact area.
- 2. Can be connected to conductors via exothermic connection or standard compression lugs.
- 3. Manufacturer:
 - a. Harger – UPC series
 - b. Or equal from Hubbell
 - c. Or Approved Equal

F. Cable Tray Clamps

- 1. Electro-tin plated cast bronze connector
- 2. UL 467 approved
- 3. Manufacturer:
 - a. Harger - TBCTC
 - b. Or equal from Hubbell
 - c. Or Approved Equal

G. Cable to Cable Connections

- 1. T-tap or Exothermic Weld
- 2. Manufacturer:
 - a. Harger RT series (T-tap) or UltraShot Weld Metal (Exothermic Weld)
 - b. Or equal from Hubbell

- c. Or Approved Equal
- H. Cable to Structural Steel Connections
 - 1. Exothermic Weld – types VA, VD, or VU
 - 2. Manufacturer:
 - a. Harger – Ultraweld series
 - b. Or equal from Hubbell
 - c. Or Approved Equal
- I. Alligator Grounding Clips
 - 1. Properly Sized with complete kit.

2.15 LABELING

- A. Cable Labeling
 - 1. For Horizontal Cables and Inside-Plant Backbone Cables
 - a. Laser/Ink Jet Self Laminating Labels
 - b. Manufacturer:
 - 1) Panduit – S100X Series
 - 2) Or equal from Brady
 - 3) Or equal from Dymo
 - 4) Or equal from Hellermann Tyton
 - 5) Or Approved Equivalent
 - 2. For Outside-Plant Backbone Cables and Innerduct
 - a. Self-laminating cable marker tag, tie on (with zip ties)
 - b. Manufacturer:
 - 1) Fiber Optic – Panduit PST-FO, Mooseline F1-0095
 - 2) Copper – Mooseline F1-0095
- B. Rack and Patch Panel Labeling
 - 1. Vinyl cloth label
 - 2. Lettering/numbering text height 3/8" to 1/2"
 - 3. Manufacturer:
 - a. Brady PTL series
 - b. Panduit PCL037 series
 - c. Or Approved Equivalent

2.16 PLYWOOD BACKBOARD

- A. Fire-treated, AC grade plywood
- B. 8' tall by 4' wide by 3/4" thick
- C. Locations as noted on Drawings
- D. Painted with two-coats of fire-retardant white paint (mask out a minimum of one stamp on each piece of plywood used)

2.17 FIRESTOPPING SYSTEMS

- A. Fire-Rated Pathway Device (Sleeve)

1. Steel pathway (sleeve) with integral intumescent firestopping material to facilitate the initial installation - and frequent moves, adds, and changes - of low-voltage voice/data, fiber, video, security, paging, etc cabling.
 2. UL System meeting the hourly fire-rating of the wall or floor type
 3. Multiple pathways in the same location shall be ganged together.
 4. Plenum-rated
 5. Manufacturer:
 - a. Specified Technologies Inc – EZ Path Fire-Rated Pathway
 - 1) 2" – Series 22
 - 2) 3" – Series 33
 - 3) 4" – Series 44
- B. Firestopping for conduit penetrations
1. For metallic conduit or tube to be installed through 1 or 2 hr fire-rated wall or floor.
 2. Manufacturer:
 - a. Gypsum board stud walls
 - 1) Specified Technologies - UL System No. W-L-1222 with SpecSeal LCI Sealant
 - b. Concrete floors or walls
 - 1) Specified Technologies – UL System No. C-AJ-1353 with SpecSeal LCI Sealant
- C. Firestopping for backboxes in fire- or smoke-rated wall
1. For Communications backboxes to be installed in 1 or 2 hr fire-rated or smoke-rated walls.
 2. STC sound rating – 64 or higher (related to specific construction)
 3. Shall meet criteria of UL263 and classified for up to hrs as a Wall Opening Protective Material (Category CLIV)
 4. Manufacturer:
 - a. Specified Technologies – SpecSeal Power Shield
- D. Smoke-Rated or Acoustical Sleeves
1. Metallic or non-metallic pathway (sleeve) with integral self-adjusting smoke and sound sealing system to facilitate the initial installation – and frequent moves, ads, and changes – of low-voltage voice/data, fiber, video, security, paging, etch cabling.
 2. L Rating – Air Leakage Test Procedure tested per UL1479 without a Fire Test
 3. Less than 1.25 cubic feet per minute for 0% fill (cable) capacity
 4. Less than 2.5 cubic feet per minute for 1 to 100% fill (cable) capacity
 5. Sound Transmission Classification (STC) – 59 or higher (related to specific construction)
 6. Plenum-rated
 7. Manufacturer:
 - a. Specified Technologies Inc – NEZ Pathway
- E. Fire-rated Conduit (Circuit Integrity) Wrap
1. Endothermic wrap for EMT and RMC for protection of cable pathways for critical life safety circuits.
 2. Tested to ASTM E1725 for circuit integrity
 3. Manufacturer:
 - a. Specified Technologies – E-Wrap Endothermic Wrap

PART 3 - EXECUTION

3.1 CODES, STANDARDS, REGULATIONS

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM B 1 Standard Specification for Hard-Drawn Copper Wire
 - 2. ASTM B 8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
 - 4. ASTM D 709 Laminated Thermosetting Materials
- C. Alliance for Telecommunications Industry Solutions (ATIS)
- D. Building Industry Consulting Service International (BICSI)
 - 1. Telecommunications Distribution Methods Manual 14th Edition
 - 2. Outside Plant Design Reference Manual 6th Edition
 - 3. ANSI/BICSI Data Center Design and Implementation Best Practices
 - 4. NECA/BICSI 568-D Standard for Installing Commercial Building Telecommunications Cabling
 - 5. NECA/BICSI 607-D, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- E. Federal Communications Commission (FCC)
 - 1. FCC Part 15, Radiated Emissions Limits
 - 2. FCC Part 68, Connection of Terminal Equipment to the Telephone Network
 - 3. FCC Part 76, Cable Television Service
- F. Insulated Cable Design Consultants Association (ICEA)
 - 1. ICEA S-87-640 Fiber Optic Outside Plant Communications Cable
 - 2. ICEA S-98-688 Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
 - 3. ICEA S-99-689 Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors
- G. International Electrotechnical Commission (IEC)
- H. Institute of Electrical and Electronics Design Consultants, Inc. (IEEE)
 - 1. IEEE Standard IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System
 - 2. IEEE Standard 1100 Recommended for practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
 - 4. IEEE C2 Errata INT National Electrical Safety Code
 - 5. IEEE Std 100 The Authoritative Dictionary of IEEE Standards Terms
- I. International Organization for Standardization (ISO)
 - 1. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
 - 2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises,

3. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration
 4. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises
 5. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration
- J. National Cable Television Association (NCTA)
- K. National Electrical Manufacturers Association (NEMA)
1. NEMA C62.61 Gas Tube Surge Arresters on Wire Line Telephone Circuits
- L. National Fire Protection Association (NFPA)
1. NFPA-70, National Electrical Code
 2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
 3. NFPA-101, Life Safety Code
 4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
 5. NFPA-780, Standard for the Installation of Lightning Protection Systems.
- M. National Institute Standards and Technology (NIST)
- N. Occupational Safety and Health Administration (OSHA)
- O. Telecommunications Industry Association (TIA)
1. ANSI/TIA-568-D, Generic Telecommunications Cabling for Customer Premises.
 2. ANSI/TIA-568-D, Commercial Building Telecommunications Cabling Standard.
 3. ANSI/TIA -568-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
 4. ANSI/TIA-568-D, Optical Fiber Cabling Components Standard.
 5. ANSI/TIA-569-E Commercial Building Standard for Telecommunications Pathways and Spaces.
 6. ANSI/TIA-606-D, Administration Standard for the Telecommunications Infrastructure.
 7. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 8. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
- P. U.S. Department of Agriculture (USDA)
1. RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction
 2. RUS Bull 1751F-643 Underground Plant Design
 3. RUS Bull 1751F-815 Electrical Protection of Outside Plant
 4. RUS Bull 1753F-201 Acceptance Tests of Telecommunications Plant (PC-4)
 5. RUS Bull 1753F-401 Splicing Copper and Fiber Optic Cables (PC-2)
 6. RUS Bull 345-65 Shield Bonding Connectors (PE-65)
 7. RUS Bull 345-72 Filled Splice Closures (PE-74)
 8. RUS Bull 345-83 Gas Tube Surge Arrestors (PE-80)
- Q. Underwriters Laboratories, Inc. (UL)
1. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
 2. UL 910 (NFPA 262) Applicable Flame Test

3.2 GENERAL REQUIREMENTS

- A. In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify the Architect/Design Consultant in writing of any such occurrences before purchasing or installing any equipment or materials. The Architect/Design Consultant will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.
- B. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the aforementioned laws, ordinances, and rules, the matter shall be referred to the Architect/Design Consultant for direction before proceeding with that part of the work.
- C. The Contractor shall be responsible for coordination with other trades to ensure any conflicts or potential conflicts are resolved prior to any work beginning on the project.
- D. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines.
- E. No deviations from the plans or specifications shall be made without full consent in writing of the Architect/Design Consultant. The Contractor shall have written approval from the Architect/Design Consultant for any additional work beyond the Contract Documents prior to beginning such work. If the Contractor does not obtain written approval from the Architect/Design Consultant prior to proceeding with the work, the contractor shall not be reimbursed for the work.
- F. The Contractor shall obtain written permission from the Architect/Design Consultant before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, or ceilings.
- G. Contractor shall perform onsite coordination with the General Contractor, Structural, MEP, and Civil as required to discuss outside plant and inside plant clash detection with other trades.

Contractor shall notify the Architect/Design Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect/Design Consultant to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- H. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- I. Equipment and materials installed by the Contractor shall be free of defects and damage.
- J. Contractor shall be responsible for the repair of any damage caused by the contractor during the installation.
- K. Contractor shall test all cables prior to installation. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective at a later date.
- L. Contractor shall maintain a set of working specifications, design drawings, and record drawings to be kept on site at all times and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect/Design Consultant.

- M. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.
- N. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.
- O. Contractor shall make all stored equipment and materials available for inspection at the request of the Architect/Design Consultant.
- P. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.
- Q. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.
- R. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.
- S. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- T. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.

3.3 SYSTEM REQUIREMENTS

- A. The contractor is responsible for furnishing materials as required to provide a complete and functioning system. Quantities are not noted, so the information may be obtained from the technology drawings.
- B. Inter-Building Cable Plant
 - 1. Fiber Optic Cable
 - a. Multimode / Singlemode
 - 1) Contractor shall furnish and install fiber optic cables as indicated on the Drawings
 - 2) Contractor shall install a 10-foot service loop at the ends of each cable to be coiled, mounted, and stored on the wall above the ladder rack.
 - 3) Cables shall be routed utilizing the pathways as indicated in the technology drawings.
 - 2. Fiber Optic Termination
 - a. Contractor shall terminate all installed fiber optic strands with fusion splice connectors and place into fiber optic enclosures with splice trays as indicated in the technology drawings.
 - b. Contractor shall furnish fiber optic enclosures and coupler panels for all fiber optic strands and blank panels for all unused slots.
 - 3. Copper Cable
 - a. High Pair Count Cable
 - 1) The Contractor shall furnish and install copper cables as indicated on the Drawings.
 - 2) The Contractor shall install a 10-foot service loop at the ends of each cable to be coiled, mounted, and stored on the wall above the ladder rack.
 - 3) Cables shall be routed utilizing the pathways as indicated in the technology drawings.

drawings.

4. High Pair Count Termination

a. Building Entrance Terminals

- 1) The contractor shall terminate copper cable pairs between the existing communications rooms on contractor furnished and installed building entrance terminals as indicated in the technology drawings.
- 2) Contractor shall furnish and install all terminals fully populated with surge protection modules.
- 3) Contractor shall ground and bond all cables and terminals.

b. Wall-mounted Wiring Blocks

- 1) The Contractor shall furnish and install wall mounted 110 wiring blocks and terminate cable whip from Building Entrance Terminal to this 110-block.
- 2) The Contractor shall furnish and install tie cables from the protector block/110 block to contractor furnished and install category 5e patch panels.
- 3) Contractor shall furnish and install tie cables/cross connects from the service provider high pair count copper cable to the owners equipment rack as required.
- 4) copper backbone pairs. Indicate proposed location on Shop Drawings.

C. Horizontal Cable

1. No horizontal cable shall be longer than two hundred ninety-five (295) feet. If any station cable will be longer than two hundred ninety-five (295) feet, Contractor shall stop installation of the cable and immediately notify Architect/Design Consultant in writing. If Contractor fails to notify the Architect/Design Consultant in writing, Contractor shall replace cable at no cost to the Owner.
2. The Contractor shall furnish and install horizontal cables within each Technology Region from the respective ER or TR to each outlet location as indicated in the technology drawings.
3. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored above the ladder rack in each respective Equipment Room or Telecommunications Room.
4. The Contractor shall provide a 2-foot service loop coiled and supported directly above the workstation outlet.

D. Horizontal Cable Termination

1. Contractor shall terminate cables as defined by the ANSI/TIA 568-D Commercial Building Wiring Standard with the EIA-568B sequence.
2. Workstations
 - a. Contractor shall furnish and install modular jacks to terminate UTP horizontal cables.
 - b. Contractor shall furnish and install faceplates, systems furniture faceplates, or surface-mount boxes to house modular jacks as indicated in the technology drawings.
 - 1) Any unused faceplate positions shall have the appropriate number and color of blanks installed.
3. Equipment Rooms / Telecommunications Rooms
 - a. Horizontal Cable for Data
 - 1) Contractor shall furnish and install patch panels and horizontal cable managers to terminate horizontal data cables as indicated in the technology drawings.
 - 2) The Contractor shall provide and install separate modular patch panels for the cabling supporting the following devices:
 - a) Network Access (Orange cabling and jacks)
 - b) Security Camera Access (Yellow cabling and jacks)

- c) Wireless Access (Orange cabling and jacks)
 - b. Horizontal Cable requiring lightning protection
 - 1) Contractor shall furnish and install lightning protection on both ends of any cables on the exterior of the building as indicated in the technology drawings.
 - 2) All lightning protection shall be installed per manufacturer's instructions including but not limited to placement and bonding requirements.
- E. Patch Cables
- 1. Fiber
 - a. Equipment Rooms / Telecommunications Room
 - 1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for 75% of the strands terminated per Equipment Room / Telecommunications Room:
 - a) 100% of the patch cables shall be (1) meters in length and stored in the applicable Equipment Room / Telecommunications Room
 - 2. Copper
 - a. Workstations
 - 1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each cable terminated.
 - 2) 100% of the patch cables shall be (5) feet in length and stored in the applicable Equipment Room / Telecommunications Room.
 - b. Equipment Rooms / Telecommunications Rooms
 - 1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each cable terminated per Equipment Room / Telecommunications Room:
 - 2) 100% of the patch cables shall be (length TBD) foot in length and stored in the applicable Equipment Room / Telecommunications Room
- F. Cable Support
- 1. All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc. as indicated in the technology drawings.
 - 2. When cables leave the main pathway systems as indicated on the technology drawings, they shall be installed and supported in Contractor furnished and installed j-hooks or adjustable cable supports.
 - 3. No cable pathway shall exceed 40% fill ratio.
 - 4. The contractor shall furnish a separate j-hook or adjustable cable support pathway for each cable type (data, paging/clock, and security).
 - 5. J-hooks and adjustable cable supports shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.
 - 6. J-hooks and adjustable cable supports shall be installed no higher than 3-feet above the accessible ceiling to allow for ease of access for future moves, adds and changes
 - 7. Do not utilize ceiling grid support wire; support j-hooks via wall, structure, or threaded rod support to structure.
 - 8. J-hooks shall be furnished with closure clips.
 - 9. Maximum sag between supports shall not exceed twelve-inches (12").
 - 10. Contractor shall establish j-hook and adjustable cable supports pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be used to support other low-voltage applications not included in this specification.

11. Contractor shall provide and install horizontal cabling in unison with the construction process and prior to the gypsum ceiling being installed.
 12. UNDER NO CIRCUMSTANCES SHALL ZIP TIES BE USED ON ANY HORIZONTAL CABLING.
 13. Cable Dressing
 - a. No nylon cable ties shall be used at any time during the installation of the cable.
 - b. Above Ceiling
 - 1) Contractor shall furnish and install plenum-rated hook & loop straps in plenum-rated airspaces.
 - a) The Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
 - c. Equipment Rooms / Telecommunications Rooms
 - 1) The Contractor shall bundle all visible cables by type (blue Cat 6A for data, blue Cat 6A for WAPs, yellow for security, white for paging, etc) with Contractor furnished and installed hook & loop straps.
 - a) Hook & loop straps shall be installed twenty-four (24) inches apart on center.
- G. Equipment Rooms / Telecommunications Room Build-Out
1. Plywood
 - a. The Contractor shall furnish and install 8' H x 4' W x 3/4" D sheets of AC grade fire-rated plywood as indicated in the technology drawings.
 - b. The Contractor shall mount all plywood vertically starting at 24" AFF.
 - c. The Contractor shall cover the plywood with two (2) coats of Contractor furnished white fire-retardant paint leaving exposed (1) fire rating stamp per sheet.
 2. Cable Runway (Ladder Type)
 - a. Contractor shall furnish and install cable runway using manufacturer-approved hardware and installation methods as indicated in the technology drawings.
 - b. Contractor shall furnish and install vertical sections of cable runway using manufacturer-approved hardware and installation methods to provide transition and support where cables enter or exit the room using a vertical pathway.
 - c. Contractor shall furnish and install radius drops cross member and stringers above each rack using manufacturer-approved hardware and installation methods where cables exit the horizontal section of the ladder rack.
 - d. Contractor shall ground and bond each cable runway section to the next utilizing ground straps and ensure metal-to-metal contact.
 3. Equipment Racks and Cabinets
 - a. Contractor shall furnish and install equipment racks with vertical management using manufacturer approved hardware and installation methods as indicated in the technology drawings.
 - b. Contractor shall secure relay racks to the concrete floor utilizing expandable concrete anchors.
 - c. Contractor shall secure the equipment racks to the cable runway using cable runway elevation kits and manufacturer approved hardware and installation methods.
 - d. Contractor shall bolt all equipment racks and vertical cable managers together.
 - e. Contractor shall individually ground and bond each equipment rack and ensure metal-to-metal contact.
 4. Patch Panels

- a. Horizontal Cabling patch Panels shall be installed as indicated in the Technology Drawings.

H. Grounding and Bonding

1. General Requirements:

- a. Ensure metal-to-metal contact for all terminations.
- b. All materials shall be UL Listed.
- c. Cable-to-cable connections and cable-to-building steel connections shall be exothermic welds. All other connections shall be made with UL Listed compression 2-hole lugs with anti-oxidation compound, utilizing both lug openings.
- d. Only one lug shall occupy a hole on the busbar. No stacking lugs or "double lugging" shall be permitted.
- e. Bonding conductors shall be sized based on length per the table on the Drawings; minimum size #6 AWG and maximum size 750kcmil.
- f. For Communications Rooms / Data Centers with a raised floor, provide a supplementary bonding grid (SGB) below the raised floor comprised of the following:
 - 1) Bare copper conductor around the perimeter of the room
 - 2) 12"x4" TGB/SBB, bonded to two points of the perimeter conductor and to the TGB/SBB above the access floor
 - 3) Bond all piping and conduit entering raised floor at the perimeter.
 - 4) Bond floor pedestal to Computer Room Air Conditioning Unit (if located in Communications Room)
 - 5) Bare copper conductor between every four stringers, running the length/width of the room in both directions; bond to every fourth pedestal in both directions and to perimeter bonding conductor.
 - 6) Bond floor pedestal to Power Distribution Unit feeder conduit below raised floor.

2. Telecom Bonding System shared with Electrical Ground System – Compliant with BICSI TDMM

- a. For a building without structural steel, Telecommunications Bonding Backbone is not required. The TMGB/PBB shall be bonded to the Electrical Ground System via a Bonding Conductor for Telecommunications. TGB/SBB shall be bonded to the grounding busbar of the serving electrical panelboard. Bonding conductor routing shall be indicated on Record Drawings.
- b. Provide label above TGB/SBB shall indicated name of electrical panelboard and the room it is located. Indicate routing on pre-construction Shop Drawings, and update with final installed routing as part of As-Built Drawings.

3. Main Communication Room (MDF / Server Room) requirements

- a. Install TMGB/PBB at 84-inches above finished floor.
- b. Bonding Conductor for Telecommunications (BCT)
 - 1) Division 26 Contractor shall provide Bonding Conductor for Telecommunications from the Electrical Ground System to the TMGB/PBB in the MDF Room.
 - 2) BCT conductor size shall be sized based on length per the table on the Drawings and shall be no smaller than the largest TBB conductor. If installed underground, install in dedicated 2-inch diameter conduit.
- c. Provide bonding conductors to the following equipment within the Communication Room (where available/installed):
 - 1) Structural steel or support beams located within the room.
 - 2) If electrical distribution panelboard serving the Communications Room is located within the Communications Room, bond TGB/SBB to ground bus of the panelboard.

- 3) Overhead ladder rack
 - 4) Equipment racks, cabinets, and enclosures
 - 5) Surge protectors / building entrance terminals
 - 6) Exposed cable shields
 - 7) Continuous metallic conduits for low-voltage cabling that stub into the Communication Room
 - 8) Any additional equipment or pathways where bonding/grounding is recommended by the equipment manufacturer or the referenced standards (TIA 607 and NECA/BICSI 607).
4. Secondary Communication Rooms (IDFs / Data Rooms)
 - a. Install TGB/SBB at 84-inches above finished floor.
 - b. Provide bonding conductors to the following equipment within the Communication Room (where available/installed):
 - 1) Structural steel or support beams located within the room.
 - 2) If electrical distribution panelboard serving the Communications Room is located within the Communications Room, bond TGB/SBB to ground bus of the panelboard.
 - 3) Overhead ladder rack
 - 4) Cable trays in corridor
 - 5) Equipment racks, cabinets, and enclosures
 - 6) Surge protectors / building entrance terminals
 - 7) Exposed cable shields
 - 8) Continuous metallic conduits for low-voltage cabling that stub into the Communication Room
 - 9) Any additional equipment or pathways where bonding/grounding is recommended by the equipment manufacturer or the referenced standards (TIA 607 and NECA/BICSI 607).
- I. Wire-mesh cable tray
 1. Coordinate with all other disciplines to ensure cable tray routing and installation is coordinated with other systems.
 2. Coordination with all other disciplines to ensure the 12-inch clearance above the tray is maintained.
 3. Any elevation changes shall have radius drops installed to support the cables properly.
 4. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Utilize 45-degree off-sets/routing to change elevation and horizontal routing.
 5. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.
 6. Where cable trays encounter a non-fire-, smoke-, or acoustically-rated wall, cut opening through wall to facilitate continuous cable tray installation through wall.
 7. Where cable trays encounter fire, smoke, or acoustically-rated wall, stop cable tray and provide Fire-or Smoke-Rated Pathway Devices. Provide number of devices to match square-inch capacity of cable tray. Devices shall be ganged together with manufacturer-specific accessory.
 8. Ground and bond cable tray in accordance with NFPA 70, TIA-607, and NECA/BICSI-607.
 - a. Bond cable tray to the Telecom Ground Bar in each Communications Rooms. Utilize #6 AWG conductor for lengths up 13 feet, a #4 AWG conductor for lengths of 14 to 20 feet, and a #3 AWG conductor for lengths of 21 to 26 feet. Refer to TIA 607 standard for conductor size requirements for lengths longer than 26 feet.
 - b. Provide ground lugs between each section of cable tray to ensure electrical continuity of cable tray installation. Where cable tray sections are separated by conduit or firestopping sleeves, provide #6 AWG bonding jumper between cable tray sections.

9. Cable Tray Supports

- a. Cable tray shall be supported by a trapeze or wall support brackets. No center support brackets shall be allowed.
- b. A minimum of 3/8-inch all-thread shall be used for trapeze supports.
- c. Support in accordance with manufacturer recommendations but at not more than 10 foot intervals.
- d. Cable tray shall be no less than 3-inches above a lay-in ceiling.
- e. Cable tray shall be rigidly supported and level.
- f. All-thread shall be covered from the attachment to the trapeze system to 3-inches above the tray to protect the cables from being chaffed.
- g. All supports shall attach to structure or a rigid surface such as a plywood backer in a sheet rock wall.
- h. Supports shall not be shared with any other discipline.

J. Firestopping

1. Fire-Rated Pathway Devices

- a. Provide Fire-Rated Pathway Device(s) wherever Communications cabling routed above accessible ceiling needs to be routed through a fire-rated wall. Quantity and size of devices shall be sized per manufacturer's published cable fill counts, leaving 25% spare capacity.
- b. Coordinate quantity, size and locations with other Division 27 Subcontractors and indicate quantity, size, location, product make and model number, and UL System number on Pre-Construction Shop Drawings.
- c. Coordinate quantity, size and locations with other Division 27 Subcontractors and indicate quantity, size, location, product make and model number, and UL System number on Pre-Construction Shop Drawings.
- d. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

2. Firestopping for Conduits

- a. Provide firestopping components as part of a UL System for all conduit penetrations through fire-rated and smoke-rated walls and floors.
- b. Coordinate locations and UL System with other Division 27 Subcontractors and indicate locations and UL System number on Pre-Construction Shop Drawings.
- c. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

3. Firestopping for Backboxes

- a. Provide firestopping component(s) as part of a UL tested/approved solution for backboxes located in fire-rated and smoke-rated walls.
- b. Coordinate locations with other Division 27 Subcontractors and indicate locations on Pre-Construction Shop Drawings.

4. Smoke-Rated / Acoustical Pathway Device

- a. Provide Smoke-Rated Pathway Device(s) wherever Communications cabling routed above accessible ceiling needs to be routed through a smoke-rated wall or through a wall of a Noise Critical Room.
- b. Quantity and size of devices shall be sized per manufacturer's published cable fill counts, leaving 40% spare capacity.

- c. Coordinate quantity, size and locations with other Division 27 Subcontractors and indicate quantity, size, location, product make and model number, and UL System number on Pre-Construction Shop Drawings.
 - d. For smoke-rated partitions: Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.
- 5. Fire-rated Conduit (Circuit Integrity) Wrap
 - a. Provide Fire-rated Conduit (Circuit Integrity) Wrap for certain Communications conduits for the following systems:
 - 1) Section 275129 Two-Way Communications System
 - 2) Section 275319 Emergency Responder Radio Coverage (ERRC) DAS
 - b. Coordinate conduit size and lengths requiring wrap with Subcontractors of those sections prior to Bid and include cost to provide that wrap in the Bid.

K. System Labeling

- 1. Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels.
- 2. Horizontal Cables shall be labeled within (12) inches from the termination point inside the Equipment Room/Telecommunications Rooms.
- 3. Horizontal Cables shall be labeled within (6) inches from the termination point at the workstation end.
- 4. Backbone Fiber and Copper Cables shall be labeled within (12) inches of the visible end of the jacket and at each pull point location. If passing through an IDF it will be labeled when entering and leaving that IDF.
- 5. Fiber Innerduct shall be labeled within (12) inches of the point of entry of the fiber optic enclosure and at each pull point location. If passing through an IDF it will be labeled when entering and leaving that IDF.
- 6. Bonding conductors shall be labeled within (12) inches from their termination point.
- 7. Cables shall be labeled identically at both ends.
- 8. Equipment Racks
 - a. Equipment racks in each Equipment/Telecommunication Room shall be labeled in sequential numeric order.
 - 1) Labels shall be centered on the top front of the equipment rack.
- 9. Cabinets
 - a. Cabinets in each Equipment/Telecommunication Room shall be labeled in sequential numeric order.
 - 1) Labels shall be centered on the top front of the Cabinet.
- 10. Fiber Optic Enclosures
 - a. Fiber optic enclosures shall be labeled alpha-numeric starting with the 1st fiber optic enclosure in the top of the 1st equipment rack.
 - b. A label for each terminated strand shall be securely placed inside each fiber optic enclosure.
- 11. Backbone Cable
 - a. Fiber Optic Cable
 - 1) Fiber optic backbone cable labels shall contain the cable origin room number, the cable destination room number, fiber strand numbers, and type (i.e. B126-A118/001-012MM).

- 2) Fiber optic couplers panels in fiber enclosures shall be labeled at each end by strand denoting building code, Equipment Room and/or Telecommunications Room, enclosure number, and strand number to and from respectively (i.e. B126/01/01-12 – A118/01/01-12).
 - b. High Pair Count Copper Cable
 - 1) For high pair count copper backbone cables, the label scheme shall contain, cable origin room number, the cable destination room number, and cable pairs (i.e. B126-A118/001-025).
12. Horizontal Cable
 - a. Inside Equipment Rooms
 - 1) Horizontal cables shall be labeled at each end with the destination end and origin room number, patch panel number, and port number. (i.e. B126-B127-A01).
 - 2) Patch panels in each closet shall be labeled sequentially starting with the first Patch Panel in the top of the first relay rack (A, B, C, D, E, etc.).
 - 3) All patch panels will indicate the room number along with the patch panel port designation. The labels shall be mechanical labels that are neatly printed with uniform font and evenly spaced across the patch panel. Room numbers will be in sequential order throughout the panels as indicated on the drawings.
 - 4) 110-type blocks shall contain the destination room number, pair numbers, and binder pair number under each pair termination. (example)
 - a) 110-type block labels shall be printed on product-specific label strips and placed into label holders.
13. Workstation Faceplates
 - a. Cables and wall plates shall be labeled denoting origin, Equipment Room/Telecommunications Room Number, Patch Panel, 110-type termination block, and Port Number. (i.e. B127-A01).
14. TMGB/PBB and TGB/SBB
 - a. TMGB/PBB and TGB/SBB shall be labeled with a unique identifier (i.e. TMGB/PBB-B126, TGB/SBB-A118).
15. Bonding Conductors
 - a. The following conductors shall be labeled at each end with the destination end and origin room number (i.e. B126 – IDFA118).
 - 1) Bonding Conductor for Telecommunications
 - 2) Telecommunications Bonding Backbone
 - 3) Grounding Equalizer

3.4 TESTING REQUIREMENTS

A. Fiber Optic Cable

1. Installed strands shall be tested and certified in accordance with industry standards.
2. Only Manufacturer Certified Technicians shall perform testing.
3. The Contractor shall test and certify all fiber optic cable strands with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
4. The Contractor shall provide calibration results from the manufacturer showing the current calibration of the testers.

5. The Contractor shall notify the Architect/Design Consultant a minimum of five (5) days in advance to observe cable testing.
6. The Architect/Design Consultant may randomly select 5% of the installed strands for test verification purposes. The Contractor shall re-test these strands in the presence of the Architect/Design Consultant and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously submitted test results, all testing shall be declared a failure and the Contractor shall re-test 100% of the installed strands at no cost to the Owner.

B. Copper Backbone Cable

1. Installed pairs shall be tested and certified in accordance with industry standards.
2. Only Manufacturer Certified Technicians shall perform testing.
3. The Contractor shall test and certify all copper pairs with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
4. The Contractor shall provide calibration results from the manufacturer showing the current calibration of the testers.
5. The Contractor shall notify the Architect/Design Consultant a minimum of five (5) days in advance to observe cable testing.
6. The Architect/Design Consultant may randomly select 5% of the installed pairs for test verification purposes. The Contractor shall re-test these pairs in the presence of the Architect/Design Consultant and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously submitted test results, all testing shall be declared a failure and the Contractor shall re-test 100% of the installed pairs at no cost to the Owner.

C. Category 6 and 6A UTP Cable

1. Cable links shall be tested in accordance with industry standards.
2. Only Manufacturer Certified Technicians shall perform testing.
3. The Contractor shall test and certify the structured cable system with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
4. No Fail or *Pass results will be accepted.
5. The Contractor shall notify the Architect/Design Consultant a minimum of five (5) days in advance to observe field testing.
6. The Architect/Design Consultant may randomly select 5% of the installed links for test verification purposes. The Contractor shall re-test these links in the presence of the Architect/Design Consultant and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously-submitted test results, all testing shall be declared a failure and the Contractor shall re-test 100% of the installed links at no cost to the Owner.

D. Grounding and Bonding

1. Main Building Ground
 - a. Coordinate with electrical contractor and provide a copy of their test results for the main building ground. The results shall be below 25 Ohms.
2. Two-Point Ground/Continuity Testing
 - a. Prior to the two-point ground testing, a visual inspection shall be performed to verify that the bonding and grounding system is installed according to the drawings and specifications and in compliance with the TIA-607-D Standard.

- b. All testing shall be conducted prior to any active equipment is installed.
- c. The Contractor shall use an earth ground resistance tester that is configured for a continuity test. This is also known as a two-point tester or a "dead earth" test.
- d. Prior to the two-point continuity test conduct a voltage test to ensure there is no stray voltage in the system.
- e. The testing shall include but is not limited to the following points.
 - 1) Building electrical grounding electrode and the TMGB/PBB.
 - 2) TGMB/PBB TGB/SBB to electrical ground in ER/TR.
 - 3) TGMB/PBB TGB/SBB to the building steel (if present).
 - 4) TMGB/PBB to each TGB/SBB.
 - 5) Building steel (if present) to the electrical ground.
- f. Per the TIA-607-D, the maximum value for resistance between any point in the telecommunications bonding and grounding system and the building's electrical grounding electrode system is 100 milliohms. In the case of long TBB and Grounding Equalizer conductor runs, the resistance of the conductor must be factored into the total resistance. For example 1 km of a No. 3/0 conductor has a resistance of 0.2028 ohms. (0.06180 ohms per 1000 ft.)
- g. The Contractor shall notify the Architect/Design Consultant a minimum of five (5) days in advance to observe field testing.

3.5 PROJECT CLOSEOUT DOCUMENTATION

A. As-Built Drawings

- 1. Drawings shall be provided to the Architect/Design Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect/Design Consultant.
- 2. Provide Drawings depicting the condition of the structured cabling system as installed.
- 3. As-Built drawings shall be produced in AutoCAD 2017 or higher and provided in hardcopy and electronically in .dwg and PDF format.
- 4. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect/Design Consultant.
- 5. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, backbone and horizontal cable pathways, workstation locations, and labeling scheme.
- 6. A laminated copy of the telecommunications room service region with the labeled work areas outlet shall be provided and hung in each telecommunications room. Drawing size will be 30"x42".

B. Test Documentation

- 1. Test documentation shall be provided to the Architect/Design Consultant at the time of substantial completion. Final payment will not be recommended until these test results are received and approved by the Architect/Design Consultant.
- 2. Provide test documentation for the structured cabling system as installed.
- 3. Test results shall be provided in original electronic format (i.e., manufacturer's proprietary testing software along with applicable reader software) and PDF electronic format.
- 4. Test documentation shall be bound, sectioned, and tabbed in the following sequence as applicable:
 - a. Tester(s) Calibration Certificate(s)
 - b. Inter-Building Backbone Fiber Optic Cable
 - c. Inter-Building Backbone Copper Cable

- d. Intra-Building Backbone Fiber Optic Cable
- e. Intra-Building Backbone Count Copper
- f. Horizontal Category 3 Cable
- g. Horizontal Category 5e Cable
- h. Horizontal Category 6 Cable
- i. Horizontal Category 6A Cable
- j. Main Building Ground
- k. Two-Point Ground/Continuity Test

C. Manufacturer's Performance Certification

- 1. Certificate shall be provided to the Architect/Design Consultant at the time of final system acceptance. Final payment will not be recommended until the certificate of certification is received and approved by the Architect/Design Consultant.
 - a. The manufacturer of the solution shall furnish a performance certification as per the specifications starting at final system acceptance.
 - b. One original and two copies of the Manufacturer's Certificate shall be provided.

D. Manufacturer's Product Warranty

- 1. Certificate of product warranty shall be provided to the Architect/Design Consultant at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect/Design Consultant.
 - a. The manufacturer of the solution shall furnish a product warranty as per the specifications starting at final system acceptance.
 - b. One original and two copies of the Manufacturer's product warranty shall be provided.

E. Contactor's Statement of Warranty

- 1. Statement of warranty shall be provided to the Architect/Design Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect/Design Consultant.
 - a. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
 - b. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e. Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION

**SECTION 28 13 00
ACCESS CONTROL SYSTEM**

PART 1 - GENERAL

1.01 SUMMARY

- A. This section identifies the requirements, technical design, and specifications for the access control system at the Laredo Community College LC Veterans Services Center, located in Laredo, Texas ("Owner"). The access control system as specified is an Industry-Standard access control system and includes access control server (existing), control panels, sub-controller panels, card readers, door position sensors, request to exit devices, cabling, power supplies, and any associated software, hardware, or licensing as specified.
- B. It is the Contractor's responsibility to visit the site, review this specification and associated project specifications and drawings in their entirety prior to bidding on the project. By bidding on this project, the Contractor acknowledges that they have read and fully understand these specifications with no exceptions. Contractor shall review the drawings, specifications, and existing conditions prior to bidding on the project. Any discrepancies shall be brought to the attention of the Architect/Design Consultant via request for information (RFI) in writing for evaluation and/or clarification. If these items are not brought to the attention of the Architect/Design Consultant, the more costly or difficult manner and the better quality or greater quantity of work shall be provided by the Contractor in accordance with the Architect's/Design Consultant's interpretation at no additional cost to the Owner. Contractor shall verify the installation methodology of each device location prior to proceeding with installation. Potential obstructions or mounting conflicts due to changing conditions shall be identified via written RFI for approval with the Architect / Design Consultant / Owner.
- C. Contractor shall furnish and install all materials, equipment, and labor necessary to provide a complete and fully functional turn-key access control system regardless of any items not listed or described in this specification or associated drawings.

1.02 REQUIREMENT SECTIONS TABLE OF CONTENTS

- 1.03 Contractor Experience Requirements
- 1.04 Submittal Requirements
- 2.01 Products – General Requirements
- 2.02 Acceptable Manufacturers
- 3.01 Codes, Standards and Regulations
- 3.02 Execution - General Requirements
- 3.03 Coordination Requirements
- 3.04 System Requirements
- 3.05 Testing Requirements
- 3.06 Training Requirements
- 3.07 Project Closeout Documentation

1.03 RELATED REQUIREMENTS

- A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 28 and shall be complied with in every respect. The Contractor shall examine all the items which make up the Contract Documents and shall coordinate them with the work on the project.

1.04 CONTRACTOR EXPERIENCE REQUIREMENTS

- A. The Contractor shall be a certified Manufacturer Preferred Partner/Dealer prior to submitting a bid for the work.
- B. The Contractor shall possess all relevant Manufacturer Certifications (i.e., access control systems, hardware installation, software installation and programming) for both the Company and individual Technicians prior to submitting a bid for the work.
- C. The Contractor shall have a Manufacturer Certified Technician onsite throughout the duration of the installation phase of the project.
- D. The Contractor's Project Manager shall be dedicated to this project for the duration of the project and shall be available for all onsite coordination meetings.
- E. The Contractor shall have been in business for a minimum of five (5) years.
- F. The Contractor shall have a local office with local Technicians and an adequate workforce to complete this project within a 75-mile radius of the project site.
- G. The Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- H. Subcontractors shall be identified at the time of bid and comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.05 SUBMITTAL REQUIREMENTS

- A. Bid / Proposal Submittal
 - 1. Contractor shall provide as part of their bid/proposal:
 - a. Breakdown of proposed parts and labor required for the completion of the project.
 - b. Proposed construction schedule in a Gant chart format
 - c. Detailed Safety Plan
 - d. Detailed documentation of QA / QC
 - e. A detailed description of the installation team(s) that would perform the work.
 - f. A resume for each of the key project personal.
 - g. A list of all Sub Contractors and their scope of work shall be identified at the time of bid. All Sub Contractors will fully comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.
 - h. Hardware, software, and licensing warranty cost for 2nd, 3rd, 4th, and 5th Year(s) extended.

- i. Manufacturer Service and Support Agreement (SSA) cost for 2nd, 3rd, 4th, and 5th Year(s) extended.
- j. Cost for associated Manufacture Representative System Training as outlined in the training section of these specifications.
- k. Cost for spare parts as outlined in these specifications.
- l. Cost for unit pricing as outlined in related specifications.

B. Pre-Installation Submittal

- 1. Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the Architect / Design Consultant / Owner.
- 2. The Contractor is responsible for notifying and obtaining written approval via RFI from the Architect / Design Consultant / Owner of any proprietary devices, software, and/or installation processes.
- 3. Contractor is responsible for obtaining permitting as required in accordance with the authority having jurisdiction (AHJ), local, city, state, federal, and/or applicable law requirements.
- 4. Contractor shall ensure submittals are submitted in ten (10) business days to ensure all products can be ordered and received on site in order to not cause any delays. Any products having long lead times (more than 60 days) that may negatively impact the schedule shall be clearly identified in writing so the review and approval can be expedited.
- 5. All submittals shall be submitted in the same sequence as they are listed in the specifications (i.e., product data in the sequence items are listed in the product data section, Manufacturer Product Certifications for Company, Manufacturer Product Certifications for Installers, etc.). Submittals not in the proper sequence will not be approved.
- 6. Contractor shall provide the following as part of their submittal:
 - a. Manufacturer product data sheets for each proposed system component.
 - 1) For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted. Product data sheets without the part number clearly identified will not be approved.
 - 2) Contractor shall identify any products that are discontinued, end of life, or near end of life, and shall propose equal alternate to the discontinued product in writing.
 - b. Manufacturer Product Certifications for Company.
 - c. Manufacturer Product Certifications for Installers.
 - d. Manufacturer Warranty Letters.
 - e. Documentation indicating that Contractor has been in business for (5) years.
 - f. Address of Contractor's local office within a 75-mile radius of the project site.

- g. Quantity of full-time, local Technicians within a 75-mile radius of the project site.
- h. List of five (5) contractor-installed projects of a similar size and scope that have been in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
- i. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
- j. List of subcontractors performing any work on the project. List shall clearly identify the subcontractor's legal name and address, the scope of work to be performed by the subcontractors and the overall percentage of the project being provided by the subcontractor. If there are no subcontractors performing any work on the project, submit a statement on Company letterhead clearly indicating no subcontractors will be performing any work on this project.
- k. Manufacturer's certification letter confirming that the proposed access control system components do not have any known cybersecurity notices, bulletins, or alerts. If a vulnerability is discovered, the contractor shall notify the Architect / Design Consultant within twenty-four (24) business hours. Provide the make and model of the associated equipment and the vulnerability.
- l. Manufacturer cybersecurity hardening guide. If one is not available, provide documentation from the Manufacturer stating such.
- m. A complete set of shop drawings to include at minimum but are not limited to:
 - 1) Proposed and/or samples of original contractor security schedules, schedules are not to be copy/paste of schedules within the contract documents (Security Contractor shall also refer to Division 27 specification, schedules, and drawings).
 - a) Card reader and equipment schedules shall include at a minimum but not limited to:
 - (1) Device Locations
 - (2) Device Power / Power Source Requirements (high and low voltage)
 - (3) MDF/IDF Layouts
 - (4) Rack Layouts
 - (5) Network Switch
 - (6) IP Address
 - (7) ACS Cable Type and Pathways
 - (8) ACS Panel Termination Schedule
 - 2) Elevation and Topography Drawings to illustrate the associated devices and equipment and the heights at which they will be installed.
 - (1) Naming Convention Information

(2) Signal Flow Diagram including full ACS topology.

- n. Supplemental documents to include but not limited to:
 - 1) Safety Plan
 - 2) Contractor QA/QC Document to include bench testing / initial configuration of all critical system components including, but not limited to:
 - a) System Server(s)
 - b) Software and Licensees
 - c) Card Readers
 - d) Control Panels
 - e) Contractor Furnished Workstations (if applicable)
 - 3) Construction Schedule in a Gant chart format
 - 4) Contractor Cybersecurity Hardening Guide
 - a) Contractor Certification Letter utilizing Company Letterhead detailing the Company policies and procedures.
 - b) Contractor shall provide a cybersecurity plan detailing their internal policy for preventing the introduction of cyberthreats to the Owner's technology / security infrastructure.
 - 5) Information on service calls, to include all rates and hours of operation
- o. Contractor extended warranty plans and costs (labor and materials) broken up by typical years:
 - 1) Years 2-4
 - 2) Years 4-6

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The following sections specifically list the acceptable equipment types and items for this project.
- B. Unless otherwise stated, all wiring, equipment, and installation materials shall be Commercial Grade, new, and of the highest quality to meet or exceed the performance and features of the equipment and devices specified herein.
- C. All devices shall be installed with the Manufacturer recommended mounts and accessories as necessary for the installation locations type as scheduled.
- D. Unless otherwise stated, all software and licensing shall be for the most current, up to date version of the system provided. For existing systems, Contractor shall obtain written verification of the Owner's most current software version and notify via RFI the Architect / Design Consultant / Owner if implementation of the most current software / license version will require an upgrade to the Owner's existing system.
- E. Architect / Design Consultant will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- F. Proposed equivalent items must be approved in writing by the Architect / Design Consultant prior to purchase or installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- G. In the event a Manufacturer's specified product or part number has changed or is no longer available, Contractor shall submit a formal RFI for an appropriate substitute.
- H. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished at no additional cost to the Owner.
- I. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- J. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.
- K. Original Equipment Manufacturer (OEM) documentation must be provided to the Architect / Design Consultant which certifies performance characteristics and compliance with ANSI/TIA/EIA 568-C standards where applicable.
- L. Contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. Contractor shall clearly identify any concerns with lead times in writing to the Architect / Design Consultant. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues, and the Contractor will have all products on-site when needed to complete the job as per the project schedule.
- M. Quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a fully functional system. Where quantities are not noted, they may be obtained from the drawings.
- N. All software, hardware, and equipment (from the date of RFP) shall be tested, currently available and commercially off the shelf product (COTS).

- O. Written approval must be obtained from the Owner / Architect / Design Consultant for any proprietary or custom software and/or equipment prior to the beginning of the project.

2.02 ACCEPTABLE MANUFACTURERS

A. Access Control System Manufacturer

- 1. Keyscan Aurora
- 2. Axis's Access Control System Solution (Alternate shall be priced separately – Per Owner approval only)
 - a. Contractor shall confirm manufacturer of Access Control System with Owner prior to procurement and installation. Contractor shall furnish and install all Axis materials, equipment, and labor necessary to provide a complete and fully functional **turn-key** Access Control System.

B. Access Control Server

- 1. Keyscan Aurora - Owner furnished / Owner installed (existing)

C. Access Control System Software

- 1. Keyscan Aurora Version 1.0.17.0 (existing)
 - a. Contractor shall include all additional software as required for the following add-on modules:
 - 1) Browser based web interface
 - 2) Mobile Application
 - 3) Cloud Software
 - 4) Client Workstation(s)
 - 5) ID Badge Printing Workstation(s)
 - 6) Active Directory
 - 7) Wireless Lockset(s) and Gateway(s)/Router(s)
 - a) Reference Division 08 Hardware Specifications and Schedules for wireless door hardware requirements (wireless door hardware, gateways/routers, and associated Division 08 peripheral devices are by Division 08)
 - 8) Contractor shall furnish, install, and program any all software as required for a complete and fully operational **turn-key** solution.

D. Access Control Licenses

- 1. Contractor shall furnish and install all licenses as required for a complete and fully operational **turn-key** solution.

E. Access Control System Hardware

- 1. Access Control Server(s)

- a. The existing server(s) shall be utilized
- b. Owner furnished / Owner installed (OFOI)
2. Client Workstation(s)
 - a. Owner furnished / Owner installed (OFOI)
3. ID Badge Printing Workstation
 - a. The existing badging printer and workstation(s) shall be utilized
 - b. Owner furnished / Owner installed (OFOI)
4. Credential(s) / Badge(s)
 - a. Owner furnished / Owner Installed (OFOI)
5. Access Control System Controller, I/O Boards, and Power Supply Enclosure(s)
 - a. Intelligent Controller(s) – Enclosed Wall Mounted
 - 1) Refer to Part 3.3 – System Requirements for additional requirements for quantity and sizing of enclosed products
 - 2) Enclosure to be contractor furnished / contractor installed per the Manufacturer requirements
 - a) Keyscan CA8500 (8-door control unit)
 - b) Keyscan NETCOM2P (1-per panel)
 - c) Plug-in Transformer (as recommended by the Manufacturer)
 - (1) Bosh D8004 (transformer enclosure)
 - d) All security enclosures shall be equipped with a tamper switch
 - b. Input / Output / Relay Board – Enclosed Wall Mounted
 - 1) Refer to Part 3.3 – System Requirements for additional requirements for quantity and sizing of enclosed products
 - 2) Enclosure to be contractor provided / contractor installed per Manufacturer requirements
 - a) Keyscan IOCB1616B (input / output board)
 - b) Keyscan OCB8 (relay board)
6. Access Control System Reader(s)
 - a. Proximity / Smart Card / Mobile Reader
 - 1) Wall Mount
 - a) Keyscan KR40SE (iCLASS SE)
 - 2) Mullion Mount

- a) KeyScan KR15SE (iCLASS SE)
- 3) Contractor shall confirm the card reader Manufacturer, type, and class with the Owner prior to procurement and installation. Card readers shall work with existing Owner credentials.
- 7. Access Control System Wiegand Signal Extenders
 - a. Keyscan WIEEX-2 (as required)
 - b. Or approved equivalent
- 8. Access Control System Credential(s)
 - a. Prox Credential
 - 1) Owner furnished / Owner installed (OFOI)
 - b. Mobile Credential
 - 1) Owner furnished / Owner installed (OFOI)
- 9. Door Position Sensor(s) (DPDT DPS to be utilized for all opening connected to the ACS and IDS)
 - a. Recessed / Concealed (190-Series)
 - 1) Color shall match door frame
 - 2) GRI-190-12WG (SPDT)
 - 3) GRI-195-12WG (DPDT)
 - 4) Or approved equivalent
 - b. Surface Mount with Armored Cable (4400-Series)
 - 1) GRI-4402-A (SPDT)
 - 2) GRI-4405-A (DPDT)
 - 3) Or approved equivalent
- 10. Tamper Switch (for each enclosed product)
 - 1) Altronix TS112 Series
 - 2) GRI-PBF-2020 Series
 - 3) Or approved equivalent
- 11. Request to Exit Device(s)
 - a. Integral with Electrified Door Hardware
 - 1) Reference Division 08 Hardware Specifications and Schedule for integral with electrified door hardware request to exit requirements (electrified door hardware with integral request to exit are by Division 08)

- b. PIR Motion
 - 1) Bosch DS160 Detector
 - 2) Bosch TP160 Trim
 - 3) Or approved equivalent
- 12. Emergency Door Release Button(s) (momentary with timer option)
 - a. Reference Division 08 Hardware Specifications and Schedule for electrified door hardware emergency door release button requirements (emergency door release button(s) are by Division 28)
 - 1) STI
 - 2) STI protective cover
 - 3) Or approved equivalent
- 13. Resistors / Resistor Packs
 - a. Contractor shall furnish and install resistors as recommended by the Manufacturer.
 - b. All security devices shall be supervised.
- F. Access Control System External Power Supplies (as required)
 - 1. 12V / 24V Enclosed Products
 - a. Altronix AL Series
 - 1) Battery backup kit
 - 2) Low voltage disconnect
 - 3) Accessory board(s) as required
 - b. Or Approved Equal
 - 2. ACS Enclosure Battery Backup
 - a. Yuasa NP12-7
 - 3. Or approved equivalent
- G. Electrified Locking Mechanism Power Supply
 - 1. Reference Division 08 Hardware Specifications and Schedules for electrified door hardware and power supply requirements (electrified door hardware, wireless door hardware, gateways/routers, power supplies and associated Division 08 peripheral devices are by Division 08)
- H. Access Control System Cabling
 - 1. Composite Cables (hardwired card reader locations)
 - a. Belden
 - b. SmartWire / Windy City Wire

- c. Southwire / Tappan
 - 1) H91602.1 Plenum (default, overall jacket yellow))
 - 2) Contractor shall properly size lock power cables based on distance from the Division 08 power supply (above opening or in centralized location) to the Division 08 electrified door hardware per the electrified door hardware requirements
 - a) Reference Division 08 Hardware Specifications and Schedules for electrified door hardware and power supply requirements
- d. Or approved equivalent
- 2. Peripheral Device(s) / Relay Interface Cables
 - a. Belden
 - b. SmartWire / Windy City Wire
 - c. Southwire / Tappan
 - 1) Door Release / Duress Button(s)
 - a) 18/4 Plenum (overall jacket, yellow)
 - 2) Relay Interface
 - a) 18/4 Plenum (confirm overall jacket color with Owner prior to procurement)
 - d. Or approved equivalent
- I. Data Cable
 - 1. Reference Division 27 Specifications
- J. Pathway Cable Support
 - 1. Panduit J-Mod Cable Support System
 - 2. Erico – CADDY CAT LINKS J-Hook Series
 - 3. Panduit Plenum Rated Velcro Hook & loop (Velcro, black)
- K. Labeling
 - 1. Permanent Labels for Copper Cables
 - a. Panduit Heat Shrink Labels
 - b. Or approved equivalent
- L. Fire Stop / Sealants
 - 1. Fire stop
 - a. STI Spec Seal

- b. 3M Products
 - c. Or approved equivalent
 - 2. Sealants
 - a. Masterseal NP1
 - b. Or approved equivalent
 - 3. Sleeves
 - a. STI EZ-PATH (sized as required)
- M. Spare Parts
 - 1. Contractor shall furnish 10% spare parts, to be turned over to the Owner at Substantial Completion
- N. Manufacturer Service and Support Agreement (SSA)
 - 1. Owner furnished / Owner installed (OFOI)

PART 3 - EXECUTION

3.01 CODES, STANDARDS, REGULATIONS

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
 - 2. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. ASTM D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
 - 4. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials
- C. Alliance for Telecommunications Industry Solutions (ATIS)
- D. Building Industry Consulting Service International (BICSI)
 - 1. Telecommunications Distribution Methods Manual 13th Edition
 - 2. Outside Plant Design Reference Manual 5th Edition
 - 3. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - 4. NECA/BICSI 568-2006 – Standard for Installing Commercial Building Telecommunications Cabling
 - 5. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- E. Federal Communications Commission (FCC)
 - 1. FCC Part 15, Radiated Emissions Limits, revised 1998
 - 2. FCC Part 68, Connection of Terminal Equipment to the Telephone Network, revised 1998
 - 3. FCC Part 76, Cable Television Service, revised 1998
- F. Insulated Cable Engineers Association (ICEA)
 - 1. ICEA S-87-640 (2006) Fiber Optic Outside Plant Communications Cable
 - 2. ICEA S-98-688 (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
 - 3. ICEA S-99-689 (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors
- G. International Electrotechnical Commission (IEC)
- H. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - 1. IEEE Standard 81-1983, IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System

2. IEEE Standard 1100-1999, Recommended for practice for Powering and Grounding Sensitive
 3. Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
 4. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
 5. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
- I. International Organization for Standardization (ISO)
1. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
 2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
 3. ISO/IEC 14443-3:2011 – Identification Cards
 4. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
- J. National Cable Television Association (NCTA)
- K. National Electrical Contractors Association (NECA)
1. NECA 1-2015 Good Workmanship in Electrical Construction
- L. National Electrical Manufacturers Association (NEMA)
1. NEMA C62.61 (1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits
- M. National Fire Protection Association (NFPA)
1. NFPA-70, National Electrical Code
 2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
 3. NFPA-101, Life Safety Code
 4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
 5. NFPA-780, Standard for the Installation of Lightning Protection Systems.
- N. National Institute Standards and Technology (NIST)
- O. Occupational Safety and Health Administration (OSHA)
- P. Security Industry Association (SIA)
- Q. Telecommunications Industry Association (TIA)
1. ANSI/TIA-568.0-D-1, Generic Telecommunications Cabling for Customer Premises.
 2. ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard.
 3. ANSI/TIA -568.0-D.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
 4. ANSI/TIA-568.3-D-1, Optical Fiber Cabling Components Standard.

5. ANSI/TIA-569-E Commercial Building Standard for Telecommunications Pathways and Spaces.
 6. ANSI/TIA-606-C, Administration Standard for the Telecommunications Infrastructure.
 7. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 8. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
- R. U.S. Department of Agriculture (USDA)
1. RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction
 2. RUS Bull 1751F-643 (2002) Underground Plant Design
 3. RUS Bull 1751F-815 (1979) Electrical Protection of Outside Plant
 4. RUS Bull 1753F-201 (1997) Acceptance Tests of Telecommunications Plant (PC-4)
 5. RUS Bull 1753F-401 (1995) Splicing Copper and Fiber Optic Cables (PC-2)
 6. RUS Bull 345-65 (1985) Shield Bonding Connectors (PE-65)
 7. RUS Bull 345-72 (1985) Filled Splice Closures (PE-74)
 8. RUS Bull 345-83 (1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
- S. Underwriters Laboratories, Inc. (UL)
1. UL 294 Standard for Access Control System Units
 2. UL 294B Standard for Power Over Ethernet (PoE) Power Sources for Access Control Systems and Equipment
 3. UL 109 Standard Method for Flame Tests of Flame-Resistant Fabrics and Films
 4. UL 1076 Standard for Proprietary Burglar Alarm Units and Systems

3.02 EXECUTION - GENERAL REQUIREMENTS

- A. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the aforementioned laws, ordinances, and rules, the matter shall be referred to the Architect / Design Consultant for direction before proceeding with that part of the work.
- B. Contractor shall meet the specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.
- C. The Contractor shall install the materials in accordance with these specifications and the Manufacturer's installation guidelines. Equipment and materials installed by the Contractor shall be free of defects and damage.

- D. No deviations from the plans, details or specifications shall be made without full consent in writing of the Architect / Design Consultant. The Contractor shall have written approval from the Architect / Design Consultant for any additional work beyond the Contract Documents prior to beginning such work.
- E. In the event site conditions do not allow the Contractor to follow the execution requirements specified herein or in the provided details, the Contractor shall submit via RFI an alternative means and methods that is approved in writing by the Architect / Design Consultant.
- F. The Contractor shall obtain written permission from the Architect / Design Consultant before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to: girders, beams, floors, walls, roofs, and/or ceilings.
- G. If the Contractor does not obtain written approval from the Architect / Design Consultant prior to proceeding with the work, the Contractor shall not be reimbursed for the work.
- H. Contractor shall notify the Architect / Design Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect / Design Consultant to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- I. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- J. Contractor shall be responsible for the repair of any damage caused by the Contractor during the installation.
- K. Contractor shall test all cables prior to and post installation. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective at a later date.
- L. Contractor shall maintain a set of working specifications, design drawings, and record drawings to be kept on site at all times and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect / Design Consultant.
- M. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same Manufacturer and model number.
- N. Equipment and materials shall be delivered and stored in accordance with the Manufacturer's guidelines at the Contractor's expense.
- O. Contractor shall make all stored equipment and materials available for inspection at the request of the Architect / Design Consultant.
- P. All equipment and material used in the installation shall be approved by the Manufacturer for the environment in which it is being installed.
- Q. Devices installed in public spaces shall be mounted and secured using tamper-proof security fasteners unless otherwise noted.
- R. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.

- S. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.
- T. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- U. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.
- V. The Manufacturer and Contractor shall take positive measures to prevent the introduction of cybersecurity threats to the Owners technology infrastructure. These measures shall include but are not limited to:
 - 1. The Contractor shall scan Contractor owned equipment for cyber threats such as viruses, malware, ransomware, etc., prior to connecting the Contractor owned devices to the Owners network.
 - 2. Ensure all Technicians installing or configuring equipment are trained on the prevention of introduction of cyber threats to electronics, i.e., servers, and other associated equipment.
 - 3. All project documents shall be properly securely stored behind encryption and password protection to avoid unauthorized distribution of documents.
- W. Labeled Doors and Frames
 - 1. In no instance shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.
 - 2. The Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Architect.

3.03 COORDINATION REQUIREMENTS

- A. The Contractor is responsible for the coordination of the following items and their respective disciplines included but not limited to.
- B. Coordinate with the Architect to ensure that:
 - 1. Adequate conduit is provided and that equipment backboxes are adequate for system installation.
 - 2. Adequate power has been provided and properly located for the security system equipment.
 - 3. Doors and door frames are properly prepared for electric locking hardware and door position switches.
 - 4. Access hatch locations (when required) shall be submitted in writing via RFI and coordinated with the Architect.
 - 5. Finishes and colors of all equipment visibly installed in public areas. Submit all finish and graphics for all equipment to the Architect for approval prior to installation.
- C. Coordinate with the Division 08 Contractor for the following:
 - 1. Door Hardware Manufacturer installation and power requirements.

2. Installation, power, and requirements for integral request to exit switches.
- D. Contractor is responsible for coordinating with gate controller installers for controller locations and interfacing terminations.
- E. Coordinate with the Division 14 (Elevators) Contractor for the following:
 1. Pathways, installation, and power requirements of ACS equipment in Elevator shafts and walls.
 2. Security device pathways and terminations to be done by elevator Contractor or under supervision of elevator Contractor.
 3. Interfacing of elevator controls to the Access Control system
 - a. Software integration is preferred
 - b. Coordinate with ACS Manufacturer for compatibility and licensing requirements
 - c. If no other method is possible, Contractor shall interface via relay cabling from the Access Control System to the designated elevator security interface.
 - 1) Ensure adequate relay signaling cabling is provided for interfacing of each floor
- F. Coordinate with the Division 26 Contractor for the following:
 1. High voltage power pathways, grounding, and bonding requirements.
 2. Drive up pedestal pathways to the interior of the building.
 3. Pathways, rough ins, back boxes, and conduit sizes for all access control peripheral devices.
- G. Coordinate with the Division 27 Contractor for the following:
 1. Installation and power requirements of network infrastructure associated to the specified Access Control System
 2. Associated patch cable lengths and quantities required for the specified Access Control System
 3. Location, power, and backup requirements for rack mount equipment.
- H. Coordinate with the Division 28 (Fire) Contractor for the following:
 1. Door Hardware Manufacturer installation and power requirements associated with fire alarm system(s).
 2. Door Hardware Manufacturer installation and power requirements for all ACS electric locking mechanisms with time-delay ("delayed egress") functions as defined by NFPA 101.
- I. The Contractor is responsible for coordinating ACS locations and mounting preferences of all specified security devices with the Architect / Design Consultant prior to installation.
- J. The Contractor is responsible for coordinating all ACS programming requirements with the Owner / Architect / Design Consultant.
- K. The Contractor shall coordinate with the Owner for the following:

1. Credential reader card formats, LED, buzzer and associated visual/audio functionalities.
2. Credential card ordering, formats, facility codes, barcode and template requirements or standards prior to install. Coordinate timelines for delivery and distribution of the credentials to the Owner prior to procurement.
3. Naming Conventions of devices, controllers, doors, etc.

3.04 SYSTEM REQUIREMENTS

A. General

1. The Access Control System (ACS) shall consist of server(s), software, licensing, workstations, doors controllers, access control cabling, credentials and all other peripheral components as indicated on the drawing and specified herein.
2. Any devices associated with the installation shall have the latest firmware updates downloads via Owner approved secure link from the system software and/or remotely from the Manufacturer.
3. All Access Control software, equipment and system requirements shall be installed per their respective Manufacturer Installation Guidelines.

B. Access Control System (ACS) Software

1. Access Control Server(s) Software
 - a. The ACS software shall be installed as the most current version; Contractor shall coordinate with Owner prior to the upgrade/install to identify and evaluate any software conflicts. Conflicts shall be brought to the attention of the design team prior to bidding via Request for Information (RFI).
2. Client Workstation(s) Software
 - a. Contractor shall coordinate the install and configure software on workstation(s) as required to provide a full turnkey ACS system.
3. Badging Workstation Software
 - a. Contractor shall coordinate the install and configure software on workstation(s) as required to provide a full turnkey ACS system.
4. Access Control System Integration Software
 - a. Per the Owner there are no integration requirements at this time.

C. Access Control System Licensing

1. Contractor shall be responsible for providing and applying all necessary licensing key(s) for the specified system(s) as required by the Manufacturer(s) for a fully functioning access control system.
2. Contractor shall maintain a secured document with all license key(s) information applicable to this project. All license key(s) are property of the Owner and shall be kept secured at all times and then surrendered to the Owner at the end of the project.

D. Access Control System Programming

1. Programming and data entry to be provide by the Contractor with assistance from the Owner as required. Contractor shall program the Access Control System to provide the following basic functions included but not limited to:
 - a. Database Importing (Active Directory, CSV file, etc.)
 - b. Graphics Maps
 - c. Time zones
 - d. System Reports
 - e. Threat / Emergency Management Protocols (Lockdown, Severe Weather, etc.)
 - f. Role Based User System Access (Admin, User Privileges, etc.)
 - g. Access levels (Areas, Floor Groups, User Groups, etc.)
 - h. Schedules (Lock/Unlock, Auto Arm/Disarm, etc.)
 - i. Auxiliary I/O Devices (Sirens, Strobos, Buzzers etc.)
 - j. Door Configuration Settings to include but not limited to:
 - 1) Anti-Pass Back
 - 2) Door Release via Push Button Input
 - 3) Door Release via Request to Exit (Maglock ONLY)
 - 4) Door Forced / Door Held Alarms Conditions
 - 5) ADA Door Settings
 - k. Special Conditions (Fire Alarm Relays, Hold Opens, Elevators, Gate / Door Operators, etc.)
- E. Access Control System Hardware
 1. ACS Server(s)
 - a. The existing access control server shall be utilized
 - 1) Contractor shall coordinate with the Owner to ensure the Owner provided server meets the ACS Manufacturer recommended specifications and requirements.
 - 2) Contractor shall coordinate with the Owner to verify existing server compatibilities and capacities for expansion as a result of the newly installed devices specified herein.
 2. Communications
 - a. Communication between servers, and workstations, networked based controllers/sub-controllers will communicate using the Owner provided data network unless otherwise noted. Coordinate with owner for network configuration requirements.
 - b. The ACS shall also support end to end 128-bit encryption unless otherwise noted.

- c. Network device communications shall be via the Owner's LAN via network cabling as specified by Division 27 (where applicable).
 - 1) Data drop shall be provided by Division 27 and located inside the controller enclosure.
 - 2) Contractor shall coordinate with Owner for addressing requirements
 - d. Alternative communications means and methods shall be provided by Division 28 where applicable.
- F. Access Control Workstation(s)
- 1. Client Workstation(s)
 - a. The Operator / Client Workstation shall be Owner furnished / Owner-installed (OFOI)
 - b. Coordinate with the Owner for locations of Client Workstation(s)
 - 2. ID Badge Printing Workstation
 - a. The ID Badge Printer and Printing Workstation shall be Owner furnished / Owner installed (OFOI)
 - b. Coordinate with Owner for locations of ID Badge Printing Workstation(s)
 - 3. Access Control System Controller(s)
 - a. Install Controller(s) in designated MDF / IDF room(s) as indicated on drawings
 - 1) The Controller(s) shall be wall mounted in the ACS Manufacturer's UL listed enclosure, unless a separate Manufacturer enclosed power supply solution is specified that is specifically designed for the controller board(s) specified herein. The enclosure shall consist of the following, but not limited to:
 - a) Single cover, hinged, with identical key cylinder lock(s) for all enclosure(s). Hinged double doors will not be accepted.
 - b) Contractor shall furnish, install, and connect tamper switch for all enclosure(s) to the controller(s) as specified. One alarm input is needed per MDF/IDF to alarm via the ACS system when the enclosure is opened.
 - c) Contractor shall furnish, install, and connect Battery Fail/Power Loss alarm inputs to the controller(s) as specified. One alarm input is needed per MDF/IDF to alarm via the ACS system in the event of low battery/power loss conditions.
 - d) Enclosure(s) shall be mounted flush, plumb, and properly secured on fire-rated plywood using appropriate mounting hardware. Pathways to or from the enclosure(s) shall mechanically protected in a conduit or gutter system. Exposed cabling is not permitted.
 - b. Device power shall be provided from a UL listed power supply or PoE powered network switch where required in accordance with the Manufacturer's requirements.
 - c. Controller(s) shall be installed per the construction documents.

- d. Controller(s) shall be installed and configured in accordance with the most current Manufacturer installation instructions.
 - e. The installation shall be performed or directly supervised by a Manufacturer Certified Technician.
 - 1) The term "supervised" means the Certified Technician shall be on-site and supervising the installation.
 - 2) The Certified (on-site) Technician shall have a copy of the Manufacturer Certification on-site readily available for review.
 - 3) The Manufacturer Certification shall be current and valid.
 - f. Provide 20% spare card reader, input point and spare alarm input points and output points after all specified points are initially connected. Sufficient modules shall be provided to accommodate only the number of card readers initially installed, as well as spare input per control panel at each communications closet or consolidation point.
- G. Access Control System Credential Readers (Cards, Vehicle Tags, PIN, Biometric)
- 1. Provide credential reader(s) as indicated on the drawings.
 - 2. Readers shall be securely mounted flush and plumb on the wall/mullion per the Manufacturer's installation guidelines.
 - 3. Exterior credential readers shall be installed with a weather-proof gasket as recommended by the Manufacturer.
 - 4. Exterior credential readers mounted on gates or vehicle pedestals shall be securely mounted in a NEMA rated weather-proof enclosure.
 - 5. Where a weather-proof gasket is not sufficient for weather-proof protection, a polyurethane sealant for exterior use shall be applied.
 - 6. Readers shall be installed with the Manufacturer provided tamper-proof security fasteners, unless otherwise approved in writing by Architect / Design Consultant. If tamper-proof security fasteners are not provided, the Contractor is responsible for procuring the requested hardware at no cost to the Owner.
- H. Access Control System Credentials (Cards, Vehicle Tags, PIN, Biometric)
- a. The Contractor shall coordinate with the Owner for starting / ending badge numbers, class requirements, and part number prior to ordering and/or procurement.
- B. Door Position Sensors (Door Contacts, Tamper Switches)
- 1. Provide magnetic concealed door position switches, surface mount door position switches and overhead door position switches to monitor the open/closed status of doors as specified herein and as indicated on the drawings.
 - 2. The Contractor shall ensure the circuit of the door position sensor shall match the physical status of the door opening i.e., Normally Closed when the door is closed.
 - 3. Exterior mounted door position sensors shall terminate using the appropriate outdoor-rated weatherproof connections and fasteners based on site conditions.

4. Provide flexible metallic conduit (as required) from the sensor location to the associated junction box as indicated on the drawings. Conduit shall be securely fastened to the structure using proper fasteners based on site conditions.
5. Contractor must ensure adequate spacing between contact and magnets to avoid abrasion / damage to the device.
6. Install end of line resistors for line supervision. Refer to Manufacturer for recommended resistance values
7. Tamper shall be mounted inside the enclosure on key switch side.

C. Request-to-Exit

1. For doors equipped with electric locking mechanical that are free exiting at all times (i.e., mortise electric locks, electric strikes, etc.), the REX motion sensor shall only shunt the door position sensor from the Access Control System unless otherwise noted.
 - a. Integrated in Electrified Door Hardware
 - 1) Security Contractor shall route cable from door controller to access controlled door as indicated on the drawings and terminate the specified cable to the top of the Division 08 installed Electrified Power Transfer Hinge.
 - a) At the time of installation of the door hardware, The Security Contractor shall provide and install all end of line resistors required by the PACS System Manufacturer.
 - b) Security Contractor shall not remove Division 08 Installed Door Hardware unless otherwise approved in writing by the Architect / Design Consultant.
 - b. Request-to-Exit Motion Sensor
 - 1) Motion sensor shall be mounted flush, plumb, and properly secured on a single gang box or mechanical brace using appropriate mounting hardware and trim plate.
 - 2) Motion sensors shall be positioned close to the door opening and angled to prevent tampering from forced entry. Contractor shall ensure devices mounted in the ceiling space are not obstructed or impacted when servicing in relation to other ceiling mounted devices (Exit signs, smoke detectors, lighting fixtures, etc.)

D. Emergency Door Release Button(s)

1. Provide emergency door release buttons in conformance with the LAHJ.

E. Card Reader Wiegand Signal Extender

1. Provide card reader Wiegand signal extension devices as necessary for card readers with cable distances to the DGP greater than 498 feet as required.
2. Provide power and associated cable as recommended by Manufacturer.

F. Electrified Door Hardware Mechanical Connections (Division 08)

1. Contractor shall conceal security cabling in door frame, door channels, walls wherever possible. Submit RFI if site conditions do not allow and propose alternative methods of terminations.

2. The Division 28 Contractor shall not make any modifications to fire rated doors without obtaining written permission from the Architect.
3. The Division 28 Contractor is responsible for providing the following:
 - a. Provide relay signal cabling only from the ACS to the Division 08 power supply or relay board(s) located either at the door or centralized location.
 - b. Termination of Lock Relay Power for PoE based networked door controllers up to the electrified door hardware.
 - c. Device power provided by Owner provided PoE networked switch.
4. The Division 08 Contractor is responsible for providing the following:
 - a. Final terminations of all internal wiring of electrified door hardware and door power supply connections.
 - b. Final terminations from the door power supply or relay board up the power transfer hinge or similar connection point of the electrified door hardware.

G. Access Control System Power Supplies

1. Unless otherwise noted, all power supplies shall be hardwired to the 120VAC circuit. No pigtails / plugs shall be acceptable.
2. Enclosed Wall Mounted Access Control Panel Power Supply
 - a. The Security Contractor shall provide and install devices as indicated on the drawings.
 - b. The Security Contractor shall provide dual voltage power supply board as specified.
 - c. The Security Contractor shall provide and install Power Control Modules as specified.
 - 1) Each lock power output cable shall be terminated to a dedicated port on the Power Distribution Module specified.
 - 2) Reference Division 08 Hardware Specifications and Schedules for requirements.
 - d. The Security Contractor shall provide and install Power Distribution Modules as specified.
 - 1) Each request-to-exit motion (where required) cable shall be terminated on a dedicated port on the Power Distribution Module.
 - e. The Security Contractor shall size each enclosure(s) with dual voltage power supplies as specified to include an additional total amperage of at least for 20% additional maximum amperage output per enclosure for future expansion as required.
 - f. The Security Contractor shall provide two (2) back up batteries as specified per each enclosure.
 - g. Hardwired power shall be provided and installed by Division 26 Electrical Contractor.
 - h. Dedicated circuit(s) shall be provided and installed by the Division 26 Electrical Contractor.
 - i. Provide U.L. Listed power supplies for all Access Control System panels as specified.

- j. Provide battery chargers and batteries for all power.
 - k. Monitor low battery and power fail alarms for each power supply.
 - l. Tamperers shall be wired as recommended by the Manufacturer.
 - 3. Backup Battery(s)
 - a. The Security Contractor shall provide and install (2) batteries per power supply enclosure.
 - b. The Security Contractor shall label the install date for each battery with printed labels.
- H. Electrified Locking Mechanism Power Supplies
 - 1. Reference Division 08 Hardware Specifications and Schedules for electrified door hardware and power supply requirements (electrified door hardware, wireless door hardware, gateways/routers, power supplies and associated Division 08 peripheral devices are by Division 08)
- I. Door Management and Local Alarm Units
 - 1. Contractor shall configure the card readers for audio and visual alarms.
- J. Access Control Cabling
 - 1. Pathways
 - a. Wires shall be routed in parallel with pathways as indicated in the technology drawings. Reference Division 27 specifications for additional requirements.
 - b. Access control cabling shall be routed separate from the network data communication cables specified in Division 27. Contractor shall provide separate pathways and j-hooks for the security cables specified herein.
 - 2. Wiring Techniques
 - a. Contractor is responsible for properly sizing cables based on distance.
 - b. All cables shall be pre-tested for shorts prior to final device terminations after cables are installed.
 - c. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored in the provided enclosure(s) as detailed in the drawings. If an enclosure is not provided for the specified devices herein, the service loop shall be installed on a j-hook in the nearest accessible ceiling space closest to the device.
 - d. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored at the access control panel.
 - e. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored on the wall above the ladder rack in the regional MDF / IDF room(s).
 - f. Install code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where the penetrations are made by or used for installation of the ACS.

- g. All wire and cable shall be continuous from device location to the final point of termination ("Home Run"). No mid-run cable splices shall be allowed.
 - h. Wire and cable within control panels, power distribution cabinets and other security enclosures shall be neatly installed, completely terminated, pulled tight with slack removed and routed in such a way as to allow direct, unimpeded access to the equipment within the enclosure. All wire and cable shall be bundled and tied. Velcro cable ties shall be utilized.
 - i. Neatly bundle and wrap all horizontal / vertical runs (above accessible ceilings and not within conduit) wire and cable at intervals as code requires. Provide supports as required. All supports shall be UL listed for the application.
 - j. All system wiring within vertical riser shafts (as required) shall be bundled, wrapped, and tied to the structure at one-meter intervals in order to isolate it from other wire and cable within the shaft. Additionally, all wire and cable within the shaft shall be supported at least every two floors using Manufacturer approved vertical management hardware and installation methods. Provide all personnel and equipment necessary to install and support the cable. All equipment shall be UL listed for the application.
 - k. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on wire and cable.
3. Splices / Transitions
- a. Home run cabling is the preferred method of installation for all Access Control System devices and panels.
 - b. In the unlikely event that a splice or transition is required, the Contractor shall identify all splices / transition points required for the completion of the project and confirm, in writing, in advance, via RFI with the Architect / Design Consultant for acceptance of the proposed wiring techniques to be utilized.
 - c. By not submitting an RFI, Contractor acknowledges that no major splicing is required for the completion of this project. Any splices not previously identified that are found to be faulty shall require the Contractor to re-install the affected cable in its entirety at no cost to the Owner.
 - d. Contractor shall clearly mark splices / transition points on the shop drawings and As-Built drawings as part of the project close-out.
4. Cable Dressing
- a. No excessive cable slack shall be left in enclosures.
 - b. Cables shall be dressed in a professional manor
 - c. Cables shall be routed in 90-degree angles to termination points inside enclosures.
 - d. Ty raps / zip ties are not permitted, hook and loop / Velcro is acceptable.
 - e. Exposed wires are not acceptable
 - f. Enclosures and equipment / Telecommunication room shall be left clean without debris including, but not limited to: labels, connectors, screws, etc.
 - g. All spare / unused cables shall be in the enclosure shall be neatly coiled and protected to avoid any shorts to ground.

K. Labeling

1. Contractor shall verify room numbers and confirm the final room numbering scheme and Owner's current standard in writing in advance via RFI prior to generating any labels.
2. Cables overall sheath shall be labeled within (6) inches from the point the cable enters/exits the enclosure inside the Equipment Room / Telecommunications / Security Control Location Rooms.
3. Cables shall be labeled within (1) inch from the termination point inside the Equipment Room / Telecommunications / Security Control Location Rooms.
4. Cables shall be labeled within (1) inch from the termination point at the device end.
5. Cables shall be labeled identically at both ends.
6. Label all controls as necessary to agree with their function.
7. All labeling in the field shall match the same labeling scheme in the closeout documents.

L. Fire Stop / Smoke / Sound Sealants

1. Use proper sealant as recommended by the Manufacturer for the specific application in compliance with per all applicable codes: City, State, Federal, LAHJ.
2. All existing pathways shall be resealed in compliance with per all applicable codes: City, State, Federal, LAHJ.

M. Grounding and Bonding

1. The Contractor shall ensure metal-to-metal contact for all grounding terminations.
2. All materials shall be UL Listed.
3. All connections shall be made with UL Listed compression 2-hole lugs.
4. Contractor shall use an anti-oxidation compound on all connections.
5. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum # 6 AWG plenum rated green insulated conductor.
6. A Grounding Equalizer conductor shall be installed when required by ANSI/TIA/EIA-607-B (Interconnects multiple TBBs on the top floor and every third floor in between).
7. The connection to building steel does not eliminate the requirement for the TBB or EBC to the service ground.
8. Equipment Bonding Conductor (EBC)
 - a. Contractor shall furnish and install a minimum #6 AWG plenum rated green insulated conductor from the TMGB or TGB as applicable to each ladder rack system, equipment rack, cabinet, metallic raceway, lightning protector, or multi-pair cable with a metallic element. Contractor shall use an anti-oxidation compound on all connections.

- b. When exceeding (13) feet the EBC shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil.

N. Conduit, Boxes and Raceways (For Reference Only - By Division 26)

1. Install all conduit necessary for a complete installation, but not provided for in the Security Drawings, in finished areas concealed in chases, furring's, concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.
2. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, industry-standard installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets, or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
3. All conduits shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
4. All required inserts shall be drilled-in, and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.
5. Swab out and remove all burrs from conduit before any wires are pulled.
6. Lay out and install conduit runs as to avoid proximity to hot pipes. In no case shall a conduit be run within 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least 25 mm from the covering of the pipe crossed.
7. Provide fire stops where conduits penetrate fire rated walls and/or floors.
8. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect.

O. High Voltage (120VAC) Power Requirements (For Reference Only – by Division 26)

1. 120VAC AC power dedicated to security shall be provided by the Electrical Contractor for the Access control system as indicated on drawings. Coordinate with the Architect to establish locations of security dedicated 120VAC AC circuits.
2. Connect to the AC power (provided by Electrical Contractor) and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.
3. Provide all conduit and wiring from the AC power facilities to the Access Control / Power Supply Enclosures.
4. Provide Mechanical separation to isolate 120VAC wires from other low voltage cabling. Low voltage cabling shall not route over / under / parallel to 120VAC wires.

P. Surge Protection / Lightning Arrestors

1. Protect all exterior devices, control, power, signal cables and conductors that are power surges. Each surge protector shall be UL Listed.
2. Unless otherwise noted, surge protection devices shall be installed at both the edge and head end of the cabling run.

3. Surge devices shall be installed as close as accessibly possible to the equipment they are protecting.
4. Surge Protection shall be properly installed in an accessible ceiling or enclosure space to allow for cable removal during troubleshooting.
5. Include surge protection device locations on as-builts and shop drawings.
6. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.
7. Properly ground surge protection devices per the Manufacturer installation requirements.

3.05 FIELD OBSERVATIONS

- A. A minimum of ten business days in advance, Contractor shall notify the Design Consultant and Owner as to the readiness for a Field Observation for the following at a minimum but not limited to:
 1. Rough-In Observation – after conduits have been installed, but before walls have been installed.
 2. Above Ceiling Observation – after cabling has been installed, but before ceilings have been installed.
 3. Final Site Observation – a minimum of two weeks before Substantial Completion.
- B. During Design Consultant's Final Site Observation of the installed systems, provide a minimum of one factory-trained / Certified Technician on the operation of all installed systems for up to (1) 8-hour day to assist with Design Consultant's functional testing.
- C. Non-Conforming Work (Punch-List)
 1. After receipt of written notice of deficiencies (Punch-List), Contractor shall correct all defective work within ten business days. If the work has been identified to be corrected by the Architect/Design Consultant, the Contractor shall remediate it in conformance with the contract documents at no cost to the Owner.

3.06 TESTING REQUIREMENTS

- A. System Start-Up
 1. The Work shall be complete and ready to operate prior to final acceptance.
 2. The Architect shall assist in establishing procedural guidelines and in defining terminology and conditions unique to the Owner's operation.
- B. Substantial Completion
 1. In order to qualify for the Architect's consideration of Substantial Completion, the Work must, at a minimum, meet the following requirements:
 - a. Installation of all devices must be completed.
 - b. All sub-system interfaces must be complete and operational.
 2. Substantial Completion shall not be misconstrued as final acceptance of the Work.

C. System Acceptance

1. Final acceptance testing of the Work will be conducted by the Architect.
2. Prior to any final acceptance testing, the Contractor shall submit two sets of preliminary (draft) Record Drawings to the Architect. The preliminary Record Drawings are to be used by the Architect to conduct the system final test.
3. Before system acceptance testing, the Security Contractor shall conduct a complete in house QA/QC test of the entire Access Control System and provide a written report on the results of that test. During the QA/QC test the Security Contractor shall place the ACS in service mode and calibrate and test all equipment.
4. Following completion of the initial testing and correction of any noted deficiencies, conduct a five day burn-in test. The intent of the burn-in test shall be to prove the Access control system by placing it in near real operating conditions. During this period, the Access control system shall be fully functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. Record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.
5. Deliver a report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs including written certification to the Architect that the installed complete Access control system has been calibrated, tested, and is fully functional as specified herein.
6. Prior to the final acceptance test, coordinate with the Architect for security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Contractor's and its Subcontractors' tools, construction equipment, machinery, and all surplus materials.
7. Upon written notification from the Contractor that the Access control system is completely installed, integrated and operational, and the burn-in testing completed, the Architect will conduct a final acceptance test of the entire system.
8. During the course of the final acceptance test by the Architect, the Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with the contract requirements. All physical and functional requirements of the project shall be demonstrated and shown. This demonstration will begin by comparing "as built" conditions of the Access control system to requirements outlined in the Specification, item by item. Following the Specification compliance review, all Access control system head-end equipment will be evaluated.
9. The functionality of the various interfaces between systems will be tested.
10. Following the Access control system head-end equipment and console review, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, backbox and conduit requirements compliance.
11. All equipment shall be on and fully operational during any and all testing procedures. Provide all personnel, equipment, and supplies necessary to perform all site testing. Provide a minimum of two employees familiar with the system for the final acceptance test. One employee shall be responsible for monitoring and verifying alarms while the

other will be required to demonstrate the function of each device. Supply at least two two-way radios for use during the test. A Manufacturer's Representative may be present on site to answer any questions that may be beyond the technical capability of the Contractor's employees, if the Contractor so elects or by specific request of the Architect or Owner, at no charge to the Architect or Owner.

12. Upon successful completion of the final acceptance test (or subsequent punch list retest) the Architect will issue a letter of final acceptance.
13. The Architect retains the right to suspend and/or terminate testing at any time when the system fails to perform as specified. In the event that it becomes necessary to suspend the test, all of the Owner's/Architect's fees and expenses related to the suspended test will be deducted from the Contractor's retainage. Furthermore, in the event it becomes necessary to suspend the test, the Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the Drawings. The Contractor shall supply the Architect with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest. During the final acceptance test, no adjustments, repairs, or modifications to the system will be conducted without the permission of the Architect.

3.07 TRAINING REQUIREMENTS

- A. Provide for eight (8) hours of training to the Owner and/or Owner's representatives. Coordinate with Owner for the exact training intent, times, dates, and duration of each training session.
- B. Provide a test report showing the system has been 100% tested and 100% operational prior to training / demonstration.
- C. Coordinate with the Owner to establish a training outline and schedule. Submit a comprehensive training curriculum to the Owner once all preliminary coordination is complete. The Owner will revise and comment on the curriculum as required.
- D. Contractor training shall be conducted onsite/virtually with a Manufacturer's Representative in attendance.
- E. Operator training shall include, but not be limited to the following:
 1. All operating procedures and graphic user interface (GUI)
 2. System configuration
 3. Alarm acknowledgement, alarm response logging, and map graphics functionality
 4. Image capture, badge printing, and print ribbon replacement.
- F. Administrative training shall include, but not be limited to the following:
 1. All operating system procedures, configuration variables and graphic user interface (GUI)
 2. Database functions and setup
 3. Cardholder input and deletion procedures
 4. Report generation
 5. Card format configuration
 6. Badge creation and design

- G. Record, label, and catalog all training on DVD and “user’s manual” written specifically for the Owner personnel onsite, for daily routine operations of the systems. Provide the DVD and user’s manual to the Owner for future in-house training sessions and / or reviews. Furnish all temporary equipment necessary for recording all training sessions. Maintain accurate and up-to-date time sheets of all training sessions.
- H. The Owner reserves the right to use any excess training hours, not used by the time of system completion, for future training as requested until the total number of training hours has been completed.

3.08 PROJECT CLOSEOUT DOCUMENTATION REQUIREMENTS

- A. As-Built Drawings
 - 1. Drawings shall be provided to the Architect / Owner / Design Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect / Owner / Design Consultant.
 - 2. Unless otherwise requested, Contractor shall provide digital copies of close-out documents, and deliver to the Architect / Owner / Design Consultant electronically.
 - 3. As-Built drawings shall be produced in AutoCAD/Revit in the most current or compatible version and provided electronically in .dwg and/or .pdf format.
 - 4. Drawings shall be provided in the original size as issued by the Architect / Design Consultant.
 - 5. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect / Design Consultant.
 - 6. Provide a conformed set of Drawings as related to the project, depicting the condition of the access control system as installed to include but not limited to:
 - a. ASI, PR and Addendum items installed throughout the duration of the project.
 - 7. Provide a hard copy of the conformed set of drawings to be physically stored at the end of the project in a designated Access Control System enclosure. Coordinate with Owner for final storage location.
 - 8. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of the following not limited to:
 - a. Access Control System Riser / Signal Flow Diagrams
 - b. Access Control System Backboard Layouts
 - 1) To include access control boards, power supplies, pathways, etc.
 - c. Sleeves, Backbone Cabling and Communication pathways
 - d. Access Control System device locations and labeling scheme.
- B. Operation & Maintenance Manuals
 - 1. Unless otherwise noted, provide O&M manuals electronically to Owner to include all drawings, product datasheets, hardware manuals as related to the project.

2. Coordinate with the Owner for provisioning of physical storage devices (Hardcopy, Flash Drive, CD/DVDs)

C. Spare Parts

1. Contractor to provide 10% spare parts as indicated below:
 - a. Intelligent Controller as specified
 - b. Network Module as specified
 - c. Door Controller as specified
 - d. I/O Boards as specified
 - e. Credential Readers as specified
2. The cost for these spare parts shall be included in the cost of the project. Spare parts are to be turned over to the Owner at substantial completion for storage.
3. These parts shall be delivered to the Owner with transmittal letter prior to final acceptance.

D. Manufacturer's Product Warranty

1. Certificate of product warranty shall be provided to the Architect / Owner / Design Consultant at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect / Design Consultant.
2. The Manufacturer of the solution shall furnish a product warranty as per the specifications starting at final system acceptance.
3. One original and two copies of the Manufacturer's product warranty shall be provided.

E. Contactor's Statement of Warranty

1. Statement of warranty shall be provided to the Architect / Design Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect / Design Consultant.
2. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
3. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e., Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION 28 13 00

SECTION 28 16 00
INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. This section identifies the requirements, technical design, and specifications for the Intrusion Detection System at Laredo Community College LC Veterans Services Center, located in Laredo, Texas ("Owner"). The Intrusion Detection System as specified is an Industry-Standard Intrusion Detection System and includes, intrusion detection control panels, input / output modules, expansion modules, keypads, motion detectors, door position sensors, cabling, transformers, power supplies, and any associated software, hardware, or licensing as specified.
- B. It is the Contractor's responsibility to visit the site, review this specification and associated project specifications and drawings in their entirety, prior to bidding on the project. By bidding on this project, the contractor acknowledges that they have read and fully understand these specifications, with no exceptions. Contractor shall review the drawings, specifications, and existing conditions prior to bidding on the project. Any discrepancies shall be brought to the attention of the Architect/Design Consultant via request for information (RFI) in writing for evaluation and or clarification. If these items are not brought to the attention of the Architect / Design Consultant the more costly or difficult manner, and the better quality or greater quantity of work shall be provided by the contractor in accordance with the Architect's / Design Consultant's interpretation at no additional cost to the owner.
- C. Contractor shall furnish and install all materials, equipment, and labor necessary to provide a complete and functional turn-key Intrusion Detection System regardless of any items not listed or described in this specification or associated drawings.
- D. Requirement Sections Table of Contents
 - 1.03 Contractor Experience Requirements
 - 1.04 Submittal Requirements
 - 2.01 Products – General Requirements
 - 2.02 Acceptable Manufacturers
 - 3.01 Codes, Standards and Regulations
 - 3.02 Execution - General Requirements
 - 3.03 Coordination Requirements
 - 3.04 System Requirements
 - 3.05 Testing Requirements
 - 3.06 Training Requirements
 - 3.08 Substantial Completion
 - 3.09 Project Closeout Documentation

1.02 RELATED REQUIREMENTS

- A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 28 and shall be complied with in every respect. The Contractor shall examine all the items which make up the Contract Documents and shall coordinate them with the work on the project.

1.03 CONTRACTOR EXPERIENCE REQUIREMENTS

- A. The Contractor shall be a certified Intrusion Detection System Partner prior to submitting a bid for the work.
- B. The Contractor shall possess all relevant Manufacturer Certifications (i.e. intrusion detection systems, hardware installation, software, and programming) for both the company and individual technicians prior to submitting a bid for the work.
- C. The Contractor shall have a manufacturer certified technician onsite throughout the duration of the installation phase of the project.
- D. The Contractor's Project Manager shall be dedicated to this project for the duration of the project and shall be available for all onsite coordination meetings.
- E. The Contractor shall have been in business for a minimum of five (5) years.
- F. The Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 75-mile radius of the project site.
- G. The Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- H. Subcontractors shall be identified at the time of bid and comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.04 SUBMITTAL REQUIREMENTS

- A. Bid / Proposal Submittal
 - 1. Contractor shall provide as part of their bid/proposal:
 - a. Breakdown of proposed parts and labor required for the completion of the project. Include documentation showing annual licensing cost of ownership.
 - b. Proposed construction schedule in a Gant chart format
 - c. Contractor Safety Plan detailing safety practices around the jobsite.
 - d. Contractor QA / QC process detailing processes and procedures to ensure quality workmanship during installation and troubleshooting.
 - e. A detailed description of the installation team(s) that would perform the work.
 - f. A resume for each of the key project personal.
 - g. A list of all Sub Contractors and their scope of work shall be identified at the time of bid. All Sub Contractors will fully comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.
 - h. Hardware, software, and licensing warranty cost for 2nd, 3rd, 4th, and 5th Year(s) extended.

- i. Manufacturer Service and Support Agreement (SSA) cost for 2nd, 3rd, 4th, and 5th Year(s) extended.
- j. Cost for associated Manufacture Representative System Training as outlined in the training section of these specifications.
- k. Cost for spare parts as outlined in these specifications.
- l. Cost for unit pricing as outlined in related specifications.

B. Pre-Installation Submittal

- 1. Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the Architect / Design Consultant.
- 2. The Contractor is responsible for notifying and obtaining written approval via RFI from the Architect / Design Consultant / Owner of any proprietary devices, software, and/or installation processes.
- 3. Contractor is responsible for obtaining permitting as required in accordance with the authority having jurisdiction (AHJ), local, city, state, federal, and/or applicable law requirements.
- 4. Contractor shall ensure submittals are submitted in 15 business days of award to ensure all products can be ordered and received on site in order to not cause any delays. Any products having long lead times (more than 60 days) that may negatively impact the schedule shall be clearly identified in writing so the review and approval can be expedited.
- 5. All submittals shall be submitted in the same sequence as they are listed in the specifications (i.e. product data in the sequence items are listed in the product data section, manufacturer product certifications for company, manufacturer product certifications for installers, etc.). Submittals not in the proper sequence will not be approved.
- 6. Contractor shall provide the following as part of their submittal:
 - a. Manufacturer product data sheets for each proposed system component.
 - 1) For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted. Product data sheets without the part number clearly identified will not be approved.
 - 2) Contractor shall identify any products that are discontinued, end of life, or near end of life, and shall propose equal alternate to the discontinued product in writing.
 - b. Manufacturer Product Certifications for Company.
 - c. Manufacturer Product Certifications for Installers.
 - d. Manufacturer Warranty letters.
 - e. Documentation indicating that Contractor has been in business for (5) years.
 - f. Address of Contractor's local office within a 75-mile radius of the project site.
 - g. Quantity of full-time, local technicians within a 75-mile radius of the project site.
 - h. List of five (5) contractor-installed projects of a similar size and scope that have been in operation for at least (1) year. The Contractor shall provide the following information

for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.

- i. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
- j. List of subcontractors performing any work on the project. List shall clearly identify the subcontractor's legal name and address, the scope of work to be performed by the subcontractors and the overall percentage of the project being provided by the subcontractor. If there are no subcontractors performing any work on the project, submit a statement on company letterhead clearly indicating no subcontractors will be performing any work on this project.
- k. Manufacturer's certification letter confirming that the proposed intrusion detection system components do not have any known cybersecurity notices, bulletins, or alerts. If a vulnerability is discovered, the contractor shall notify the Architect / Design Consultant within 24 business hours. Provide the make and model of the associated equipment and the vulnerability.
- l. Manufacturer cybersecurity hardening guide. If one is not available, provide documentation from the manufacturer stating such.
- m. A complete set of shop drawings to include at minimum but are not limited to:
 - 1) Proposed and/or samples of original contractor security schedules. Schedules are not to be copy/paste of schedules provided within the contract documents. Schedules proposed shall be utilized as part of As-Built drawings with coordination with Div. 27 for additional information as required for network components.
 - a) Device and equipment schedules shall include at a minimum but are not limited to:
 - (1) Device Label
 - (2) Device Type
 - (3) Device Power Requirements
 - (4) Terminating MDF / IDF / Panel Location
 - b) Additional networking information as required to include:
 - (1) Rack
 - (2) Network switch
 - (3) IP addresses
 - (4) Patch panel
 - (5) Surge/lighting protection
 - (6) Power source

- 2) Elevation and Topography Drawings to illustrate the associated devices and equipment and the heights at which they will be installed.
- 3) Signal Flow Diagram including full security topology.
- n. Supplemental documents to include at a minimum but are not limited to:
 - 1) Contractor Safety Plan detailing steps Contractor will take to ensure a safe work environment.
 - 2) Contractor QA/QC Document to include bench testing / initial configuration of all critical system components including but not limited to:
 - a) Panels(s)
 - b) Module(s)
 - c) Peripheral Device(s)
 - d) Central Monitoring Connections (if applicable)
 - 3) Construction Schedule in a Gant chart format
 - 4) Contractor Cybersecurity Hardening Guide detailing Contractor's internal policies for preventing the introduction of cyberthreats to the Owner's technology / security infrastructure.
 - a) Contractor Certification Letter utilizing company letterhead detailing the company policies and procedures.
 - b) Contractor shall provide a cybersecurity plan detailing their internal policy for preventing the introduction of cyberthreats to the Owner's technology / security infrastructure.
 - 5) Information on service calls, to include all rates and hours of operation
- o. Provide as alternate Contractor extended warranty plans and costs (labor and materials) broken up by typical years:
 - 1) Years 2-4
 - 2) Years 4-6

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The following sections specifically list the acceptable equipment types and items for this project.
- B. All software, hardware, and equipment (from the date of RFP) shall be tested, currently available and commercially off the shelf product. (COTS).
- C. All wiring, equipment, and installation materials shall be Commercial Grade, new, and of the highest quality to meet or exceed the performance and features of the equipment and devices specified herein.
- D. Written approval must be obtained from the Architect / Design Consultant / Owner for any proprietary or custom software and/or equipment prior to the beginning of the project.
- E. All devices shall be installed with the manufacturer recommended mounts and accessories as necessary for the installation locations type as scheduled.
- F. Unless otherwise stated, all software and licensing shall be for the most current, up to date version of the system provided. For existing systems, Contractor shall obtain written verification of the Owner's most current software version and notify via RFI the Architect / Design Consultant / Owner if implementation of the most current software / license version will require an upgrade to the Owner's existing system.
- G. Architect / Design Consultant / Owner will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- H. Proposed equivalent items must be approved in writing by the Architect / Design Consultant / Owner prior to purchase or installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- I. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall submit a formal RFI for an appropriate substitute.
- J. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished at no additional cost to the owner.
- K. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- L. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.
- M. Contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. Contractor shall clearly identify any concerns with lead times in writing to the Architect / Design Consultant / Owner. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues and the Contractor will have all products on-site when needed to complete the job as per the project schedule.
- N. Any quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a fully functional turkey system. Where quantities are not noted, Contractor shall refer to drawings and schedules to determine exact quantities.

2.02 ACCEPTABLE MANUFACTURERS

- A. Intrusion Detection System Manufacturer
 - 1. Bosch
 - 2. Or approved equivalent
 - 3. ***Contractor shall confirm the IDS Manufacturer with the Owner prior to procurement and installation. IDS and peripheral devices shall work with existing IDS systems (alternate buildings) and Owner's central monitoring station. Confirm exact requirements with the Owner.***
- B. Intrusion Detection System Panels And Modules
 - 1. Main Alarm Panel (As Required)
 - a. Bosch B9512G Control Panel
 - b. Network, Pots/Voice, and Wireless Modules as required. *(Contractor to confirm exact requirements with the Owner prior to procurement and installation)*
 - c. Or approved equivalent
 - 2. Expansion Module
 - a. Bosch SDI2 B208 Octo-input Module
 - b. Or approved equivalent
 - 3. Keypad
 - a. Bosch B915
 - 1) Provide the following for surface mount applications:
 - a) Bosch B56 Surface Mount Box
 - b) STI-7510D Polycarbonate Enclosure with Key Lock - Clear
 - (1) Mount vertically with provided conduit inserts.
 - 2) Provide the following for recessed mount applications:
 - a) STI-7510E Polycarbonate Enclosure with Key Lock – Clear
 - (1) Mount vertically.
 - 3) Or approved equivalent
 - b. Or approved equivalent
- C. Intrusion Detection Devices
 - 1. Motion Sensors
 - a. Short Range
 - 1) Bosch ISC-CDL1-W15G –PIR & MW Wall Mounted Motion Detector.
 - a) Provide Bosch B328 Gimbal Mount
 - b) Or approved equivalent
 - 2) Or approved equivalent
 - b. Long Range
 - 1) Bosch ISC-PDL1-WC30G – TriTech Curtain Motion

- a) Provide Bosch B238 Gimbal Mount
 - b) Or approved equivalent
 - 2) Or approved equivalent
 - c. Ceiling Mount
 - 1) Bosch DS9360 TriTech PIR/Microwave Detector
 - a) Provide 1-Gang Non-Metallic Low Voltage Old Work Bracket for ceiling tile mount applications
 - (1) Carlon
 - (2) Or approved equivalent
 - 2) Or approved equivalent
- 2. Door Position Sensor(s) (DPDT DPS to be utilized for all openings connected to the IDS and ACS)
 - a. Recessed / Concealed (190-Series)
 - 1) Color shall match finish of door frame
 - 2) GRI-190-12WG (SPDT)
 - 3) GRI-195-12WG (DPDT)
 - 4) Or approved equivalent
 - b. Surface Mount with Armored Cable (4400-Series)
 - 1) GRI-4402-A (SPDT)
 - 2) GRI-4405-A (DPDT)
 - 3) Or approved equivalent
- 3. Tamper Switch (for each enclosed product)
 - a. Altronix TS112 Series
 - b. GRIP BF-2020 Series
 - c. Or approved equivalent
- 4. Electric Siren
 - a. Bosch D116 Indoor Siren
 - b. Or approved equivalent
- 5. Duress Button (Latching)
 - a. Honeywell 269R
 - 1) Armored cable
 - b. Or approved equivalent
- 6. Resistors / Resistor Packs
 - a. Contractor shall furnish and install resistors as recommended by the Manufacturer.
 - b. All security devices shall be supervised.

D. Power Equipment

- 1. Enclosed Power Supply

- a. LifeSafety Unified Power Bosch Security
 - 1) FPO150-Series
 - b. Or approved Altronix equivalent
 - c. Or approved equivalent
 2. Plug-in Transformer plug-in, 16V 40VA
 - a. Bosch D1640
 - b. Or approved equivalent
 3. Transformer Enclosure
 - a. Mier BW-375GGUL Transformer Enclosure
 - b. Or approved equivalent
 4. Battery 12V 7ah
 - a. Yuasa NP7-12
 - b. Or approved equivalent
 5. UPS
 - a. Owner furnished / Owner installed (OFOI)
- E. Intrusion Detection System Cabling
1. All cabling shall be White Overall Jacket unless otherwise noted.
 2. All cabling shall be rated for the environment for which it is installed (Plenum, OSP, etc.)
 3. All cabling shall be properly sized based on distance for power supply for voltage drop.
 4. Acceptable Cable Manufacturers
 - a. Superior Essex
 - b. Windy City Wire
 - c. Belden
 - d. Or approved equal
 5. Provide cabling as required in the following configurations:
 - a. SDI2 Intrusion Backbone Cabling
 - 1) 18 AWG / 4C
 - b. Expansion Module Communication Cable
 - 1) 18 AWG /4C
 - c. Keypad Cable
 - 1) 18 AWG /4C
 - d. Motion Sensor cable
 - 1) 18 AWG / 4C
 - e. Door Contact Cable
 - 1) 22 AWG / 2C
 - f. Contractor shall properly size cables based on distance from power supply for voltage drop.

6. Data / Voice Cable
 - a. Reference Division 27 10 00 Structured Cabling System – Security Contractor responsible for providing and installing data cabling from the owner provided network to the Bosch IDS control panel. The Contractor shall provide and install data cabling in accordance with the owner's standards.
7. Pathway Cable Support
 - a. Panduit J-Mod Cable Support System
 - b. Erico – CADDY CAT LINKS J-Hook Series
 - c. Panduit Plenum Rated Velcro Hook & loop (velcro) (Black)
8. Labeling
 - a. Permanent Labels for Copper Cables
 - b. Panduit Self-Laminating Labels
 - c. Or approved equal
9. Fire Stop / Sealants
 - a. Fire stop
 - b. STI Spec Seal
 - c. 3M Products
 - d. Masterseal NP1
 - e. Or approved equivalent
10. Sleeves
 - a. STI EZ-Path Sleeves (sized as required)
 - b. Or approved equivalent

PART 3 - EXECUTION

3.01 CODES, STANDARDS, REGULATIONS

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
 - 2. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. ASTM D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
 - 4. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials
- C. Alliance for Telecommunications Industry Solutions (ATIS)
- D. Building Industry Consulting Service International (BICSI)
 - 1. Telecommunications Distribution Methods Manual 13th Edition
 - 2. Outside Plant Design Reference Manual 5th Edition
 - 3. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - 4. NECA/BICSI 568-2006 – Standard for Installing Commercial Building Telecommunications Cabling
 - 5. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- E. Federal Communications Commission (FCC)
 - 1. FCC Part 15, Radiated Emissions Limits, revised 1998.
 - 2. FCC Part 68, Connection of Terminal Equipment to the Telephone Network, revised 1998
 - 3. FCC Part 76, Cable Television Service, revised 1998
- F. Federal Information Processing Standards (FIPS)
 - 1. Advanced Encryption Standard (AES) (FIPS197)
 - 2. FIPS201-2: listed components will provide an intrusion detection solution that is fully FIPS 201-2 compliant.
 - 3. Personal Identity Verification (PIV) of Federal Employees and Contractors
- G. Homeland Security Presidential Directive 12 (HSPD12)
- H. Insulated Cable Engineers Association (ICEA)
 - 1. ICEA S-87-640 (2006) Fiber Optic Outside Plant Communications Cable
 - 2. ICEA S-98-688 (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
 - 3. ICEA S-99-689 (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors
- I. International Electrotechnical Commission (IEC)

- J. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - 1. IEEE Standard 81-1983, IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System
 - 2. IEEE Standard 1100-1999, Recommended for practice for Powering and Grounding Sensitive
 - 3. Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
 - 4. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
 - 5. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
- K. International Organization for Standardization (ISO)
 - 1. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
 - 2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
 - 3. ISO/IEC 14443-3:2011 – Identification Cards
 - 4. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
- L. National Cable Television Association (NCTA)
- M. National Electrical Contractors Association (NECA)
 - 1. NECA 1-2015 Good Workmanship in Electrical Construction
- N. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA C62.61 (1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits
- O. National Fire Protection Association (NFPA)
 - 1. NFPA-70, National Electrical Code
 - 2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
 - 3. NFPA-101, Life Safety Code
 - 4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
 - 5. NFPA-780, Standard for the Installation of Lightning Protection Systems.
- P. National Institute Standards and Technology (NIST)
- Q. Occupational Safety and Health Administration (OSHA)
- R. Security Industry Association (SIA)
- S. Telecommunications Industry Association (TIA)
 - 1. ANSI/TIA-568.0-D-1, Generic Telecommunications Cabling for Customer Premises.
 - 2. ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard.
 - 3. ANSI/TIA -568.0-D.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
 - 4. ANSI/TIA-568.3-D-1, Optical Fiber Cabling Components Standard.

5. ANSI/TIA-569-E Commercial Building Standard for Telecommunications Pathways and Spaces.
 6. ANSI/TIA-606-C, Administration Standard for the Telecommunications Infrastructure.
 7. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 8. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
- T. U.S. Department of Agriculture (USDA)
1. RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction
 2. RUS Bull 1751F-643 (2002) Underground Plant Design
 3. RUS Bull 1751F-815 (1979) Electrical Protection of Outside Plant
 4. RUS Bull 1753F-201 (1997) Acceptance Tests of Telecommunications Plant (PC-4)
 5. RUS Bull 1753F-401 (1995) Splicing Copper and Fiber Optic Cables (PC-2)
 6. RUS Bull 345-65 (1985) Shield Bonding Connectors (PE-65)
 7. RUS Bull 345-72 (1985) Filled Splice Closures (PE-74)
 8. RUS Bull 345-83 (1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
- U. Underwriters Laboratories, Inc. (UL)
1. UL 294 Standard for Intrusion detection System Units
 2. UL 294B Standard for Power Over Ethernet (PoE) Power Sources for Intrusion detection Systems and Equipment
 3. UL 109 Standard Method for Flame Tests of Flame-Resistant Fabrics and Films
 4. UL 1076 Standard for Proprietary Burglar Alarm Units and Systems

3.02 EXECUTION - GENERAL REQUIREMENTS

- A. The scope of work includes the removal of the existing intrusion detection system (Napco), including but not limited to existing door contacts, motion sensors, keypads, existing power supplies, existing intrusion control panels, cabling, and associated devices. The Security Contractor will be responsible for maintaining security for the building while removing the existing intrusion detection system, and installing the new intrusion detection system noted herein, with no down time to the building security. A project schedule of which buildings will require new intrusion cabling is included in the execution section of this documents.
- B. The Contractor's Project Manager will conduct a weekly status meeting with the Owner, and Architect / Design Consultant.
1. The meeting will be held in person or virtual and shall take approximately one hour per week. (Date and time to be determined)
 2. The Status meeting agenda will include:
 - a. Safety report
 - b. Project Milestones/Open/Closed Items
 - c. Current Project Status. (Detailed review of the construction schedule)
 - d. Upcoming Milestones/Open/Closed Items

- e. 3-week look-ahead
 - f. QC/QA report
 - g. Owner dependencies
 - h. New Business
3. The Contractor will also document all "Lesson Learned" events and document these lessons learned with the Owner, Architect / Design Consultant.
- C. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the laws, ordinances, and rules, the matter shall be referred to the Architect / Design Consultant for direction before proceeding with that part of the work.
- D. Contractor shall meet the specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.
- E. All devices shall be securely mounted to the existing structure using the correct anchoring systems for the site conditions. All devices will be mounted level and plumb. All devices installed outside of an air-conditioned area will be installed weathertight.
- F. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines. Equipment and materials installed by the Contractor shall be free of defects and damage.
- G. No deviations from the plans, details or specifications shall be made without full consent in writing of the Architect / Design Consultant. The Contractor shall have written approval from the Architect / Design Consultant for any additional work beyond the Contract Documents prior to beginning such work.
- H. In the event site conditions do not allow the contractor to follow the execution requirements specified herein or in the provided details, the Contractor shall submit via RFI an alternative means and methods that is approved in writing by the Architect/Design Consultant.
- I. The Contractor shall obtain written permission from the Architect/Design Consultant before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, and/or ceilings.
- J. If the Contractor does not obtain written approval from the Architect / Design Consultant prior to proceeding with the work, the contractor shall not be reimbursed for the work.
- K. The Contractor shall notify the Architect/Design Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect / Design Consultant to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- L. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items daily and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- M. The Contractor shall be responsible for the repair of any damage caused by the contractor during the demo and installation of the system.
- N. The Contractor shall test all cables prior to and post installation. The results of the testing will be made available to the owner and Design Consultant within 2 weeks of the performance of the

test. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective later.

- O. The Contractor shall maintain a set of working specifications, design drawings, and record drawings to be always kept on site and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect/Design Consultant.
- P. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.
- Q. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.
- R. No materials for this project will be used on other projects.
- S. The Contractor shall make all stored equipment and materials available for inspection at the request of the Architect/Design Consultant.
- T. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.
- U. All devices installed in public areas shall be mounted and secured using tamper-proof security fasteners unless otherwise noted.
- V. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.
- W. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.
- X. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- Y. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.
- Z. The manufacturer and contractor shall take positive measures to prevent the introduction of cybersecurity threats to the Owners technology infrastructure. These measures shall include but are not limited to:
 - 1. The contractor shall scan contractor owned equipment for cyber threats such as viruses, malware, ransomware, etc., prior to connecting the contractor owned devices to the Owners network.
 - 2. Ensure all technicians installing or configuring equipment are trained on the prevention of introduction of cyber threats to electronics, i.e., servers, and other associated equipment.
 - 3. All project documents shall be properly securely stored behind encryption and password protection to avoid unauthorized distribution of documents.
- AA. Labeled Doors and Frames
 - 1. In no instance shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.

2. The Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Architect.

3.03 COORDINATION REQUIREMENTS

- A. The Contractor is responsible for the coordination of the following items and their respective disciplines included but not limited to.
- B. Coordinate with the Architect/Design Consultant to ensure that:
 1. Adequate conduit is provided and that equipment backboxes are adequate for system installation.
 2. Adequate power has been provided and properly located for the security system equipment.
 3. Doors and door frames are properly prepared for door position switches.
 4. Access hatch locations (when required) shall be submitted in writing via RFI and coordinated with the Architect.
 5. Finishes and colors of all equipment visibly installed in public areas. Submit all finish and graphics for all equipment to the Architect for approval prior to installation.
 6. Where conduit/pathways and 120VAC service is required, the Contractor will provide these systems and services as part of their project scope.
 7. Access hatch locations (when required) shall be submitted in writing via RFI and coordinated with the Architect.
 8. Finishes and colors of all equipment visibly installed in public areas. Submit all finish and graphics for all equipment to the Architect for approval prior to installation.
- C. Coordinate with the Division 26 (The Security Contractor to subcontract electrical contractor for the following):
 1. High voltage power pathways, grounding, and bonding requirements.
 2. Drive up pedestal pathways to the interior of the building (as required).
 3. Pathways, rough ins, back boxes, and conduit sizes for all intrusion detection peripheral devices.
- D. Coordinate with the Division 27 (Security Contractor to subcontract data cabling contractor for the following):
 1. Installation and power requirements of network infrastructure associated to the specified Intrusion Detection System.
 2. Associated patch cable lengths and quantities required for the specified Intrusion Detection System
 3. Location, power, and backup requirements for rack mount equipment.
 4. The Contractor will coordinate with the Owner for IP address and network connection to Bosch head-end software and dispatch.
- E. Coordinate with the Division 28 (Fire) contractor for the following:
 1. Door hardware manufacturer installation and power requirements associated with fire alarm system(s).

2. The Contractor will coordinate with the Owner's fire alarm contractor for any release relays that maybe required. (Confirm with AHJ)
 3. Door hardware manufacturer installation and power requirements for all ACS electric locking mechanisms with time-delay ("delayed egress") functions as defined by NFPA 101.
- F. The Contractor is responsible for coordinating Intrusion Detection System device locations and mounting preferences of all specified security devices with the Architect / Design Consultant prior to installation.
- G. The Contractor is responsible for coordinating all Intrusion Detection System programming requirements with the Owner / Architect / Design Consultant.
- H. The Contractor shall coordinate with the Owner for the following:
1. Alarm Areas
 2. Bypass able Points
 3. 24/7 Monitored Points
 4. Global Arming Functionality
 5. Secondary Language (if required)
 6. Alarm, Trouble and Supervisory Points
 7. Keypad Codes
 8. Entry / Exit Delays
 9. Followers
 10. Line Supervision (EOL Resistance Values)
 11. Board / Keypad Addressing and termination schedule
 12. Naming Conventions of devices, controllers, doors, etc.
- I. The Contractor shall program the new IDS systems to communicate to the owner's central alarm monitoring station. The Contractor shall carefully coordinate the zone information and post alarm orders with the owner in advance of final testing to assure that the new IDS is configured to the owner's requirements.

3.04 SYSTEM REQUIREMENTS

- A. General
1. The Intrusion Detection System (IDS) shall consist of control panels, power supplies, security cabling, and all other peripheral components as indicated on the drawing and specified herein.
 2. Any devices associated with the installation shall have the latest firmware updates downloads via owner approved secure link from the system software and/or remotely from the manufacturer.
 3. All IDS software, equipment and system requirements shall be installed per their respective Manufacturer Installation guidelines and instructions.
 4. All programming and configuration to be performed by the Contractor unless otherwise noted.
- B. Communications

1. The Owner will monitor all panels 24/7 via pots/internet network connections in panels. Secondary monitoring will be provided by Owner via internal radio system and telephone communications as backup monitoring and notification. All panels and termination points of system will be in MDF and IDF rooms.
2. Install RS-485 conductor cables as required for backbone wiring between panels.
3. The communication between the IDS and servers, workstations and networked based devices shall be provided by the Owner. Owner provided data network unless otherwise noted. Coordinate with owner for network configuration requirements.
4. The IDS shall also support end to end 128-bit encryption unless otherwise noted.
5. The IDS control panel will utilize IP Data communications provided by the owner to communicate to the central alarm monitoring station.
6. The IDS control panel will utilize IP Data communications for owner programing and adds/changes
7. Network device communications shall be via the Owner's LAN via network cabling as required.
 - a. Data drop shall be provided by Division 28 and located inside the IDS enclosure.
 - b. Contractor shall coordinate with owner for addressing requirements
8. Alternative communications means & methods shall be provided by Division 28 where applicable.

C. IDS Control Workstations

1. Operator/Client Workstation
 - a. The Operator/Client Workstation shall be Owner-Furnished, Owner-Installed
 - b. All owner operator interfaces with the system shall be through system workstations and shall display real-time system messages, data files and records, operator instructions, data programming information and custom graphic illustrations.
 - c. A system workstation keyboard and mouse shall provide for entry of operator commands and acknowledgments, and system database queries.
 - d. System workstations shall not be proprietary to the Contractor. The Owner shall be able to purchase additional system workstations from computer vendors other than the Contractor.

D. IDS Control Panel

1. Install Controller(s) in designated MDF/IDF room(s) as indicated on drawings
 - a. The Controller(s) shall be wall mounted in the IDS manufacturer's UL listed enclosure, unless a separate manufacturer enclosed power supply solution is specified that is specifically designed for the controller board(s) specified herein. The enclosure shall consist of the following
 - 1) Single cover, hinged, with identical key cylinder lock(s) for all enclosure(s). Hinged double doors will not be accepted.
 - 2) Contractor shall furnish, install, and connect a tamper switch for all enclosure(s) to the controller(s) as specified. One alarm input is needed per MDF/IDF to alarm via the IDS system when the enclosure is opened.

- 3) Contractor shall furnish, install, and connect Battery Fail/Power Loss alarm inputs to the controller(s) as specified. One alarm input is needed per MDF/IDF to alarm via the IDS system in the event of low battery/power loss conditions.
 - 4) Enclosure(s) shall be mounted flush, plumb, and properly secured on fire-rated plywood using appropriate mounting hardware. Pathways to or from the enclosure(s) shall mechanically protected in a conduit or gutter system. Exposed cabling is not permitted.
 2. Device power shall be provided from a UL listed power supply where required in accordance with the manufacturer's requirements.
 3. Controller(s) shall be installed per the construction documents.
 4. Controller(s) shall be installed and configured in accordance with the most current manufacturer installation instructions.
 5. The installation shall be performed or directly supervised by a manufacturer-certified technician.
 - a. The term "supervised" means the certified technician shall be on-site and supervising the installation.
 - b. The certified (on-site) technician shall have a copy of the manufacturer certification on-site readily available for review.
 - c. The manufacturer certification shall be current and valid.
- E. IDS field devices:
 1. Provide IDS device(s) as indicated on the drawings.
 2. Devices shall be securely mounted flush and plumb on the surface per the manufacturer installation guidelines.
 3. IDS devices in public areas shall be installed with tamper-proof security fasteners, unless otherwise approved in writing by Architect / Design Consultant. If tamper-proof security fasteners are not provided, the contractor is responsible for procuring the requested hardware at no cost to the owner.
 4. Contractor shall confirm orientation and door swing of enclosures, protective covers, etc. prior to installation. Contractor is responsible for the re-orientation and patching or repairing of walls due to incorrect installation at no additional cost to the Owner.
- F. Door Position Sensors (Door Contacts, Tamper Switches)
 1. Provide magnetic door position contacts concealed and/or surface mount and overhead door position switches to monitor the open/closed status of doors as specified herein and as indicated on the drawings.
 2. The contractor shall ensure the circuit of the door position sensor shall match the physical status of the door opening i.e., Normally Closed when the door is closed.
 3. Exterior mounted door position sensors shall terminate using the appropriate outdoor-rated weatherproof connections and fasteners based on site conditions.
 4. Provide flexible metallic conduit (as required) from the sensor location to the associated junction box as indicated on the drawings. Conduit shall be securely fastened to the structure using proper fasteners based on site conditions.
 5. Contractor must ensure adequate spacing between contact and magnets to avoid abrasion / damage to the device.

6. Install end of line resistors for line supervision. Refer to manufacturer for recommended resistance values
7. Tamper shall be mounted inside the enclosure on key switch side.

G. Motion Detection Sensor

1. Motion sensor shall be mounted flush, plumb, and properly secured on a single gang box or mechanical brace using appropriate mounting hardware and trim plate.
2. Contractor shall ensure devices mounted in the ceiling space are not obstructed or impacted when servicing in relation to other ceiling mounted devices (Exit signs, smoke detectors, lighting fixtures, etc.)
3. Contractor shall adjust sensitivity and applicable features (pet immunity, anti-masking) in accordance with the Owner's standards.

H. IDS Power Supplies

1. Unless otherwise noted, all power supplies shall be hardwired to the 120VAC circuit. No pigtails / plugs shall be acceptable.
2. Enclosed Wall Mounted IDS Control Panel Power Supply
 - a. The Security Contractor shall provide and install devices as indicated on the drawings.
 - b. The Security contractor shall provide low (single) voltage power supply board as specified.
 - c. The Security Contractor shall provide and install Power Control Modules as specified.
 - 1) Each power output cable shall be terminated to a dedicated port on the Power Distribution Module specified.
 - d. The Security Contractor shall provide and install Power Distribution Modules as specified.
 - e. The Security Contractor shall size each enclosure(s) with single voltage power supplies as specified to include an additional total amperage of at least for 20% additional maximum amperage output per enclosure for future expansion as required.
 - f. The Security contractor shall provide (2) back up batteries as specified per each enclosure.
 - g. 110 VAC 20 Amp dedicated circuit hardwired power shall be provided and installed by Division 26 Electrical Contractor (Security Contractor is responsible for securing an electrical contractor as part of their scope of work).
 - h. Provide U.L. Listed power supplies for all IDS panels as specified.
 - i. Provide battery chargers and batteries for all power.
 - j. Monitor low battery and power fail alarms for each power supply.
 - k. Tamperers shall be wired as recommended by the manufacturer.

I. Backup Battery(s)

1. The Security Contractor shall provide and install (2) batteries per power supply enclosure.
2. Each Battery will be installed on a dielectric surface and labeled with the installation month and year on the front of the battery.

J. IDS Control Cabling

1. Pathways
 - a. Wires shall be routed utilizing the pathways where possible.
 - b. IDS control cabling shall be routed separate from the network data communication cables. The Security Contractor shall provide separate pathways and j-hooks for the cables specified herein.
 - c. Provide surface mounted raceways where necessary after coordinating with the Owner / Design Consultant.
2. Wiring Techniques
 - a. All cables shall be pre-tested for shorts prior to final device terminations after cables are installed.
 - b. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored in the provided enclosure(s) as detailed in the drawings. If an enclosure is not provided for the specified devices herein, the service loop shall be installed on a j-hook in the nearest accessible ceiling space closest to the device.
 - c. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored at the IDS control panel.
 - d. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored on the wall above the ladder rack in the regional MDF / IDF room(s).
 - e. Install code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where the penetrations are made by or used for installation of the IDS.
 - f. All wire and cable shall be continuous from device location to the final point of termination ("Home Run"). No mid-run cable splices shall be allowed.
 - g. Wire and cable within control panels, power distribution cabinets and other security enclosures shall be neatly installed, completely terminated, pulled tight with slack removed and routed in such a way as to allow direct, unimpeded access to the equipment within the enclosure. All wire and cable shall be bundled and tied. Only Velcro cable ties shall be utilized.
 - h. Neatly bundle and wrap all horizontal / vertical runs (above accessible ceilings and not within conduit) wire and cable at intervals as code requires. Provide supports as required. All supports shall be UL listed for the application.
 - i. All system wiring within vertical riser shafts (as required) shall be bundled, wrapped, and tied to the structure at one-meter intervals to isolate it from other wire and cable within the shaft. Additionally, all wire and cable within the shaft shall be supported at least every two floors using manufacturer approved vertical management hardware and installation methods. Provide all personnel and equipment necessary to install and support the cable. All equipment shall be UL listed for the application.
 - j. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on wire and cable.
 - k. Provide surface mounted raceway for any exposed security wiring required to connect device.
3. Splices / Transitions
 - a. Home run cabling is the preferred method of installation for all IDS devices and panels.
 - b. In the unlikely event that a splice or transition is required, the Contractor shall identify all splices / transition points required for the completion of the project and confirm, in

writing, in advance, via RFI with the Architect / Design Consultant for acceptance of the proposed wiring techniques to be utilized.

- c. By not submitting an RFI, Contractor acknowledges that no major splicing is required for the completion of this project. Any splices not previously identified that are found to be faulty shall require the Contractor to re-install the affected cable in its entirety at no cost to the Owner.
 - d. Contractor shall clearly mark splices / transition points on the shop drawings and As-Built drawings as part of the project close-out.
4. Cable Dressing
- a. No excessive cable slack shall be left in enclosures.
 - b. Cables shall be dressed in a professional manor
 - c. Cables shall be routed in 90-degree angles to termination points inside enclosures.
 - d. Ty raps / zip ties are not permitted, hook and loop / Velcro are acceptable.
 - e. Exposed wires are not acceptable
 - f. Enclosures and equipment / Telecommunication room shall be left clean without debris including but not limited to labels, connectors, screws, etc.
 - g. All spare / unused cables shall be in the enclosure shall be neatly coiled and protected to avoid any shorts to ground.
5. Labeling
- a. Contractor shall verify room numbers and confirm the final room numbering scheme and Owner's current standard in writing in advance via RFI prior to generating any labels.
 - b. Cables overall sheath shall be labeled within (6) inches from the point the cable enters/exits the enclosure inside the Equipment Room / Telecommunications / Security Control Location Rooms.
 - c. Cables shall be labeled within (1) inch from the termination point inside the Equipment Room / Telecommunications / Security Control Location Rooms.
 - d. Cables shall be labeled within (1) inch from the termination point at the device end.
 - e. Cables shall be labeled identically at both ends.
 - f. Label all controls as necessary to agree with their function.
 - g. All labeling in the field shall match the same labeling scheme in the closeout documents.

K. Fire Stop / Smoke / Sound Sealants

- 1. Use proper sealant as recommended by the manufacturer for the specific application in compliance with per all applicable codes: City, State, Federal, LAHJ.
- 2. All existing pathways shall be resealed in compliance with per all applicable codes: City, State, Federal, LAHJ.

L. Grounding and Bonding

- 1. The Contractor shall ensure metal-to-metal contact for all grounding terminations.
- 2. All materials shall be UL Listed.
- 3. All connections shall be made with UL Listed compression 2-hole lugs.

4. Contractor shall use an anti-oxidation compound on all connections.
5. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum # 6 AWG plenum rated green insulated conductor.
6. A Grounding Equalizer conductor shall be installed when required by ANSI/TIA/EIA-607-B (Interconnects multiple TBBs on the top floor and every 3rd floor in between).
7. The connection to building steel does not eliminate the requirement for the TBB or EBC to the service ground.

M. Equipment Bonding Conductor (EBC)

1. Contractor shall furnish and install a minimum #6 AWG plenum rated green insulated conductor from the TMGB or TGB as applicable to each ladder rack system, equipment rack, cabinet, metallic raceway, lightning protector, or multi-pair cable with a metallic element. Contractor shall use an anti-oxidation compound on all connections.
2. When exceeding (13) feet the EBC shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil.

N. Conduit, Boxes and Raceways

1. Install all conduit necessary for a complete installation, but not provided for in the Security Drawings, in finished areas concealed in chases, furring's, concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.
2. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, industry-standard installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets, or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
3. All conduits shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
4. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.
5. Swab out and remove all burrs from conduit before any wires are pulled.
6. Lay out and install conduit runs as to avoid proximity to hot pipes. In no case shall a conduit be run within 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least 25 mm from the covering of the pipe crossed.
7. Provide fire stops where conduits penetrate fire rated walls and/or floors.
8. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect.

O. High Voltage (120VAC) Power Requirements

1. 120VAC AC power dedicated to security shall be provided by the Security Contractor by subcontracting an electrical contractor for the IDS as indicated on drawings. Coordinate with the Architect to establish locations of security dedicated 120VAC AC circuits.
2. Connect to the AC power (provided by electrical contractor) and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.

3. Provide all conduit and wiring from the AC power facilities to the IDS / Power Supply Enclosures.
4. Provide Mechanical separation to isolate 120VAC wires from other low voltage cabling. Low voltage cabling shall not route over/under/parallel to 120VAC wires.

3.05 TESTING REQUIREMENTS

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% walk tested and approved. Final test shall be witnessed by Owner, and Design Consultant performed by the Installing Contractor. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.
- C. System Start-Up
 1. The Architect/Design Consultant shall assist in establishing procedural guidelines and in defining terminology and conditions unique to the Owner's operation.
 2. Prior to any acceptance testing, the Contractor shall preform an initial test of the IDS and correct any noted deficiencies. The Contractor shall conduct a 48 hours burn-in test. The intent of the burn-in test shall be to prove up the IDS by placing it in near real operating conditions. During this period, the IDS shall be fully functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. The Contractor shall record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.
 3. The Contractor shall deliver a report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs including written certification to the Architect/ Design Consultant that the IDS has been calibrated, tested, and is fully functional as specified herein.
 4. During the testing phase the Contractor shall test each component of the installation, creating a punch list of all deficiencies found as well as all corrective actions taken to clear up the deficiencies.
 5. Prior to substantial completion inspection by the Owner and Architect/Design Consultant the Contractor will provide a written report of all the punch list of all deficiencies found as well as all corrective actions taken to clear up the deficiencies and provide assurance that the system is fully operational and ready for inspection.
 6. The Contractor will assure that the central station is in communications with the IDS and that all points are monitored, and post orders are delivered and understood by the central station.
 7. Prior to any testing, the Contractor shall submit two sets of preliminary (draft) Record Drawings to the Architect/Design Consultant. The preliminary Record Drawings are to be used by the Architect/ Design Consultant to conduct the system final test.

3.06 SUBSTANTIAL COMPLETION/OWNER ACCEPTANCE

- A. To qualify for the Architect/Design Consultant consideration of Substantial Completion, the Work must, at a minimum, meet the following requirements:
- B. Installation of all devices must be completed.
- C. The IDS must be fully functional and operational.

- D. Before system Substantial Completion testing, the Security Contractor shall conduct a complete in-house QA/QC test of the entire IDS and provide a written report on the results of that test. During the QA/QC test the Security Contractor shall place the IDS in service mode and calibrate and test all equipment.
- E. Installation of all devices must be completed. Test results provided in a report by the Contractor to the owner and Architect/Design Consultant
- F. All devices shall be installed per the specifications and drawings.
- G. All requirements of the specifications and drawings completed.
- H. Full system test results provided in a report by the Contractor.
- I. All punch list of all deficiencies as all corrective actions taken.
- J. All sub-system interfaces must be complete and operational.
- K. Substantial completion shall not be misconstrued as final acceptance of the Work.
- L. Upon written notification from the Contractor that the IDS is completely installed, integrated and operational, and the burn-in testing completed. The Contractor shall schedule and be present and conduct the Substantial Completion test with the Architect/Design Consultant. The final owner acceptance test shall be conducted in the presence of the Owner and Design Consultant.
- M. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Contractor's and its subcontractors' tools, construction equipment, machinery, and all surplus materials.
- N. The Architect/Design Consultant and the Contractor will perform a functional Substantial Completion test and inspection of the installation prior to inviting Owner Acceptance. The Contractor will assure that all devices and systems are fully operation and that all punch list deficiencies as all corrective actions taken as part of the Substantial Completion functional test and inspection.
- O. The Architect/Design Consultant retains the right to suspend and/or terminate testing and inspection at any time when the system fails to perform as specified. If it becomes necessary to suspend the test/inspection, all the Owner's/Architect/Design Consultant's fees and expenses related to the suspended test will be deducted from the Contractor's retainage. Furthermore, in the event it becomes necessary to suspend the test/inspection, the Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the Drawings. The Contractor shall supply the Architect/Design Consultant with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest.
- P. During the final owner acceptance test by the Owner and Design Consultant the Contractor shall be responsible for demonstrating that, without exception, the completed system complies with the contract requirements. All physical and functional requirements of the project shall be demonstrated and shown. This demonstration will begin by comparing "as built" conditions of the IDS to requirements outlined in the Specification, item by item. Following the Specification compliance review, all IDS equipment will be evaluated.
- Q. The functionality of the various interfaces between systems will be tested.
 - 1. Intrusion detection interface for alarm event notification
 - 2. Central Station communications and post orders/zones

3. Duress and lock-down/lock-out

- R. Following the IDS head-end equipment, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, backbox and conduit requirements compliance.
- S. All equipment shall be on and fully operational during all testing procedures. The Contractor will provide all personnel, equipment, and supplies necessary to perform all site testing. Provide a minimum of two employees familiar with the system for the final acceptance test. A Bosch representative may be present on site to answer any questions that may be beyond the technical capability of the Contractor's employees, if the Contractor so elects or by specific request of the Architect or Owner, at no charge to the Architect or Owner.
- T. Upon successful completion of the final owner acceptance test the Architect/Design Consultant will issue a letter of final acceptance.

3.07 TRAINING REQUIREMENTS

- A. The Contractor shall provide for (2) hours of basic operator training for up to five (5) persons on each system per site/school/building location.
 - 1. Operator training shall include but not be limited to:
 - 2. Arming, disarming, and if applicable: global arm, zone arming, admin functions, alarm bypassing
 - 3. General operation of the IDS
 - 4. Basic trouble shooting of the IDS
- B. The Contractor shall coordinate with the Owner to establish a training outline and schedule. Submit a comprehensive training curriculum to the Owner once all preliminary coordination is complete. The Owner will revise and comment on the curriculum as required.
- C. Contractor training shall be conducted onsite with a manufacturer's representative in attendance.
- D. The Owner reserves the right to use any excess training hours, not used by the time of system completion, for future training as requested until the total number of training hours has been completed.

3.08 PROJECT CLOSEOUT DOCUMENTATION REQUIREMENTS

- A. As-Built Drawings.
 - 1. The Contractor shall provide:
 - a. Drawings shall be provided to the Architect / Owner / Design Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect / Owner / Design Consultant.
 - b. Unless otherwise requested, Contractor shall provide digital copies of close-out documents, and deliver to the Architect / Owner / Design Consultant electronically.
 - c. As-Built drawings shall be produced in AutoCAD/Revit in the most current or compatible version and provided electronically in .dwg and/or .pdf format.
 - d. Drawings shall be provided in the original size as issued by the Architect / Design Consultant.

- e. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect / Design Consultant.
- f. Provide a conformed set of Drawings as related to the project, depicting the condition of the IDS as installed to include but not limited to:
 - 1) ASI, PR and Addendum items installed throughout the duration of the project.
- g. Provide a hard copy of the conformed set of drawings to be physically stored at the end of the project in a designated IDS enclosure. Coordinate with Owner for final storage location.
- h. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of the following not limited to:
 - 1) Detailed IDS Riser / Signal Flow Diagrams
 - 2) Detailed IDS Control System Backboard Layouts
 - a) To include IDS control boards, power supplies, pathways, etc.
 - 3) Sleeves, Backbone Cabling and Communication pathways.
 - 4) Details of the installation of all devices and systems.
 - 5) Detailed schedule noting device naming conventions, wiring, and cabling naming conventions, device termination by IDF/MDF location, point termination of controller panels.
 - 6) Detailed IDS device locations and labeling scheme.

B. Owner and Operations manuals

- 1. Unless otherwise noted, provide O&M manuals electronically to Owner to include all drawings, product datasheets, hardware manuals as related to the project. Final payment will not be recommended until all O&M manuals are received and approved by the Architect / Owner / Design Consultant.
- 2. Coordinate with the Owner for provisioning of physical storage devices (Hardcopy, Flash Drive, CD/DVDs)

C. Manufacturer's Product Warranty

- 1. IDS system warranty shall commence at the date of final acceptance by the owner.
- 2. Certificate of product warranty shall be provided to the Architect / Owner / Design Consultant at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect / Design Consultant.
- 3. The manufacturer of the solution shall furnish a product warranty as per the specifications starting at final system acceptance.
- 4. One original and two copies of the Manufacturer's product warranty shall be provided.

D. Contactor's Statement of Warranty

- 1. Statement of warranty shall be provided to the Architect / Design Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect / Design Consultant.
- 2. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.

3. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e., Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION 28 16 00

**SECTION 28 23 00
VIDEO SURVEILLANCE SYSTEM**

PART 1 - GENERAL

1.01 SUMMARY

- A. This section identifies the requirements, technical design, and specifications for the Video Surveillance system at the Laredo Community College Veterans Services Center Renovations, located in Laredo, Texas ("Owner"). The video surveillance system as specified is an industry-standard and includes video surveillance server(s) (existing), cameras, camera mounts, camera accessories, surge/lighting protection, cabling (By Division 27) and any associated software, hardware, or licenses as specified.
- B. It is the Contractor's responsibility to visit the site, review this specification and associated project specifications and drawings in their entirety prior to bidding on the project. By bidding on this project, the contractor acknowledges that they have read and fully understand these specifications with no exceptions. Contractor shall review the drawings, specifications, and existing conditions prior to bidding on the project. Any discrepancies shall be brought to the attention of the Architect/Design Consultant via request for information (RFI) in writing for evaluation and/or clarification. If these items are not brought to the attention of the Architect/Design Consultant, the more costly or difficult manner and the better quality or greater quantity of work shall be provided by the contractor in accordance with the Architect's/Design Consultant's interpretation at no additional cost to the Owner. Contractor shall verify the installation methodology of each device location prior to proceeding with installation. Potential obstructions or mounting conflicts due to changing conditions shall be identified via written RFI for approval with the Architect / Design Consultant / Owner.
- C. Contractor shall furnish and install all materials, equipment, and labor necessary to provide a complete and fully functional **turn-key** video surveillance system regardless of any items not listed or described in this specification or associated drawings.

1.02 REQUIREMENT SECTIONS TABLE OF CONTENTS

- 1.05 Contractor Experience Requirements
- 1.06 Submittal Requirements
- 2.01 Products – General Requirements
- 2.02 Acceptable Manufacturers
- 3.01 Codes, Standards and Regulations
- 3.02 Execution - General Requirements
- 3.03 Coordination Requirements
- 3.04 System Requirements
- 3.05 Testing Requirements
- 3.06 Training Requirements
- 3.07 Demonstration and Adjustment Requirements
- 3.08 Project Closeout Documentation

1.03 RELATED REQUIREMENTS

- A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 28 and shall be complied with in every respect. The Contractor shall examine all the items which make up the Contract Documents and shall coordinate them with the work on the project.

1.04 CONTRACTOR EXPERIENCE REQUIREMENTS

- A. The Contractor shall be a certified Manufacture Preferred Partner/Dealer prior to submitting a bid for the work.
- B. The Contractor shall possess all relevant Manufacturer Certifications (i.e., video surveillance systems, hardware installation, software installation and programming) for both the company and individual technicians prior to submitting a bid for the work.
- C. The Contractor shall have a Manufacturer Certified Technician onsite throughout the duration of the installation phase of the project.
- D. The Contractor's Project Manager shall be dedicated to this project for the duration of the project and shall be available for all onsite coordination meetings.
- E. The Contractor shall have been in business for a minimum of five (5) years.
- F. The Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 75-mile radius of the project site.
- G. The Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- H. Subcontractors shall be identified at the time of bid and comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.05 SUBMITTAL REQUIREMENTS

- A. Bid / Proposal Submittal
 - 1. Contractor shall provide as part of their bid/proposal:
 - a. Breakdown of proposed parts and labor required for the completion of the project.
 - b. Proposed construction schedule in a Gant chart format
 - c. Detailed Safety Plan
 - d. Detailed documentation of QA / QC
 - e. A detailed description of the installation team(s) that would perform the work.
 - f. A resume for each of the key project personal.
 - g. A list of all Sub Contractors and their scope of work shall be identified at the time of bid. All Sub Contractors will fully comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.
 - h. Hardware, software, and licensing warranty cost for 2nd, 3rd, 4th, and 5th Year(s) extended.

- i. Manufacturer Service and Support Agreement (SSA) cost for 2nd, 3rd, 4th, and 5th Year(s) extended.
- j. Cost for associated Manufacture Representative System Training as outlined in the training section of these specifications.
- k. Cost for spare parts as outlined in these specifications.
- l. Cost for unit pricing as outlined in related specifications.

B. Pre-Installation Submittal

- 1. Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the Architect / Design Consultant / Owner.
- 2. The Contractor is responsible for notifying and obtaining written approval via RFI from the Architect / Design Consultant / Owner of any proprietary devices, software, and/or installation processes.
- 3. Contractor is responsible for obtaining permitting as required in accordance with the authority having jurisdiction (AHJ), local, city, state, federal, and/or applicable law requirements.
- 4. Contractor shall ensure submittals are submitted in ten (10) business days of award to ensure all products can be ordered and received on site in order to not cause any delays. Any products having long lead times (more than 60 days) that may negatively impact the schedule shall be clearly identified in writing so the review and approval can be expedited.
- 5. All submittals shall be submitted in the same sequence as they are listed in the specifications (i.e., product data in the sequence items are listed in the product data section, manufacturer product certifications for company, manufacturer product certifications for installers, etc.). Submittals not in the proper sequence will not be approved.
- 6. Contractor shall provide the following as part of their submittal:
 - a. Manufacturer product data sheets for each proposed system component.
 - 1) For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted. Product data sheets without the part number clearly identified will not be approved.
 - 2) Contractor shall identify any products that are discontinued, end of life, or near end of life, and shall propose equal alternate to the discontinued product in writing.
 - b. Manufacturer Product Certifications for Company.
 - c. Manufacturer Product Certifications for Installers.
 - d. Manufacturer Warranty Letters.
 - e. Documentation indicating that Contractor has been in business for (5) years.
 - f. Address of Contractor's local office within a 75-mile radius of the project site.

- g. Quantity of full-time, local technicians within a 75-mile radius of the project site.
- h. List of five (5) contractor-installed projects of a similar size and scope that have been in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
- i. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
- j. List of subcontractors performing any work on the project. List shall clearly identify the subcontractor's legal name and address, the scope of work to be performed by the subcontractors and the overall percentage of the project being provided by the subcontractor. If there are no subcontractors performing any work on the project, submit a statement on company letterhead clearly indicating no subcontractors will be performing any work on this project.
- k. Manufacturer's Certification Letter confirming that the proposed video surveillance system components do not have any known cybersecurity notices, bulletins, or alerts. If a vulnerability is discovered, the contractor shall notify the Architect / Design Consultant / Owner within twenty-four (24) business hours. Provide the make and model of the associated equipment and the vulnerability.
- l. Manufacturer Cybersecurity Hardening Guide. If one is not available, provide documentation from the manufacturer stating such.
- m. A complete set of shop drawings to include at a minimum but are not limited to:
 - 1) Proposed and/or samples of original contractor security schedules, schedules are not to be copy/paste of schedules within the contract documents (Security Contractor shall also refer to Division 27 specification, schedules, and drawings).
 - a) Camera and equipment schedules shall include at a minimum but are not limited to:
 - (1) Device Locations
 - (2) Device Power / Power Source Requirements (high and low voltage)
 - (3) MDF/IDF Layouts
 - (4) Rack Layouts
 - (5) Network Switch
 - (6) IP Addresses
 - (7) VSS Patch Panel Schedule
 - (8) Surge/Lighting Protection
 - 2) Elevation and Topography Drawings to illustrate the associated devices and equipment and the heights at which they will be installed.
 - a) Naming Convention Information

- b) Signal Flow Diagram including full VSS topology.
- n. Supplemental documents to include but are not limited to:
 - 1) Safety Plan
 - 2) Contractor QA/QC Document to include bench testing / initial configuration of all critical system components including, but not limited to:
 - a) System Server(s)
 - b) Software
 - c) Cameras
 - d) Contractor Furnished Workstations (if applicable)
 - 3) Construction Schedule in a Gant chart format
 - 4) Contractor Cybersecurity Hardening Guide
 - a) Contractor Certification Letter utilizing Company Letterhead detailing the company policies and procedures.
 - b) Contractor shall provide a cybersecurity plan detailing their internal policy for preventing the introduction of cyberthreats to the Owner's technology / security infrastructure.
 - 5) Information on service calls, to include all rates and hours of operation
 - 6) Contractor extended warranty plans and costs (labor and materials) broken up by typical years:
 - a) Years 2-4
 - b) Years 4-6

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The following sections specifically list the acceptable equipment types and items for this project.
- B. Unless otherwise stated, all wiring, equipment, and installation materials shall be Commercial Grade, new, and of the highest quality to meet or exceed the performance and features of the equipment and devices specified herein.
- C. All devices shall be installed with the manufacturer recommended mounts and accessories as necessary for the installation locations type as scheduled.
- D. Unless otherwise stated, all software and licensing shall be for the most current, up to date version of the system provided. For existing systems, Contractor shall obtain written verification of the Owner's most current software version, and notify via RFI the Architect / Design Consultant / Owner if implementation of the most current software / license version will require an upgrade to the Owner's existing system.
- E. Architect / Design Consultant / Owner will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- F. Proposed equivalent items must be approved in writing by the Architect / Design Consultant / Owner prior to purchase or installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- G. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall submit a formal RFI for an appropriate substitute.
- H. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished at no additional cost to the Owner.
- I. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- J. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.
- K. Original Equipment Manufacturer (OEM) documentation must be provided to the Architect / Design Consultant which certifies performance characteristics and compliance with ANSI/TIA/EIA 568-C standards where applicable.
- L. Contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. Contractor shall clearly identify any concerns with lead times in writing to the Architect / Design Consultant / Owner. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues, and the Contractor will have all products on-site when needed to complete the job as per the project schedule.
- M. Quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a fully functional turkey system. Where quantities are not noted, they may be obtained from the drawings.
- N. All software, hardware, and equipment (from the date of RFP) shall be tested, currently available and commercially off the shelf product. (COTS).

- O. Written approval must be obtained from the Architect / Design Consultant / Owner for any proprietary or custom software and/or equipment prior to the beginning of the project.

2.02 ACCEPTABLE MANUFACTURERS

- A. Video Surveillance System Manufacturer
 - 1. Qognify Ocularis
- B. Video Surveillance System Software
 - 1. Qognify Ocularis Version 6.1 (existing)
 - a. Contractor shall include all additional software and programming as required for the following add-on modules:
 - 1) Browser based web interface – Web Client
 - 2) Mobile Application
 - 3) Cloud Software
 - 4) Clint Workstation(s)
 - 5) Contractor shall furnish, install and program all additional software as required for a complete and fully operational turn-key solution.
- C. Video Surveillance System Licensing
 - 1. Unless otherwise noted, all licensing for the specified system and add on components shall be Lifetime, Enterprise level licensing for the system and devices specified herein
 - 2. Contractor shall verify with the Owner's existing system for current maximum licensing capacities and notify via RFI if the installation of the project will exceed the current system capacities
 - 3. Contractor shall furnish and install all additional licenses as required for a complete and fully operational turn-key solution.
- D. Video Surveillance System Hardware
 - 1. Video Surveillance Server(s)
 - a. Owner furnished / Owner installed (existing)
 - 2. Client Workstation(s)
 - a. Owner furnished / Owner installed (OFOI)
 - 3. Video Surveillance Camera
 - a. Interior
 - 1) Axis Q3536-LVE (4MP Dome)
 - a) Additional accessories as required
 - b. Exterior

- 1) Axis Q3538-LVE (8MP Dome)
 - a) Additional accessories as required
 - c. Camera Brackets and Accessories
 - 1) Contractor shall furnish and install all camera bracket and any associated accessories as recommended by the Manufacturer for proper installation per the application required for capturing the optimal field of view for each location.
 4. Uninterruptible Power Supply (UPS) / Battery Backup
 - a. Owner finished / Owner installed (OFOI)
 5. Video Surveillance System Surge Suppression Device
 - a. Refer to Part 3.3 - System Requirements for additional requirements
 - b. The Surge Suppression Device consist of one of the following:
 - 1) Head End Equipment (MDF/IDF)
 - a) Ditek DTK-RM24NETS
 - (1) DTK-NETMS (Modules)
 - b) Or approved equivalent
 - 2) Device End (Edge)
 - a) Ditek DTK-MRJPOES (Indoor)
 - b) Ditek DTK-MRJPOEX (Outdoor)
 - c) Or approved equivalent
- E. Video Surveillance System Data Cabling
 1. Reference Division 27 Specifications
- F. Pathway Cable Support
 1. Panduit J-Mod Cable Support System
 2. Erico – CADDY CAT LINKS J-Hook Series
 3. Panduit Plenum Rated Velcro Hook & loop (Velcro, black)
- G. Device Labeling
 1. Portable Label Printer
 - a. BMP21-Plus Portable Label Printer
 - 1) Provide white tape, black text ribbon in size and quantities as required for the device installation. Refer to Part 3.3 Device Labeling subsection for additional requirements

- b. Or approved equivalent
 - 2. Permanent Labels for Copper Cables
 - a. Reference Division 27 Specifications for cable labeling requirements
- H. Fire Stop / Sealants
 - 1. Fire stop
 - a. STI Spec Seal
 - b. 3M Products
 - c. Or approved equal
 - 2. Sealants
 - a. Masterseal NP1
 - b. Or approved equal
- I. Spare Parts
 - 1. Contractor shall furnish 10% spare parts, to be turned over the Owner at Substantial Completion
- J. Manufacturer Service and Support Agreement (SSA)
 - 1. Owner furnished / Owner installed (OFOI)

PART 3 - EXECUTION

3.01 CODES, STANDARDS, REGULATIONS

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
 - 2. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. ASTM D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
 - 4. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials
- C. Alliance for Telecommunications Industry Solutions (ATIS)
- D. Building Industry Consulting Service International (BICSI)
 - 1. Telecommunications Distribution Methods Manual 13th Edition
 - 2. Outside Plant Design Reference Manual 5th Edition
 - 3. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - 4. NECA/BICSI 568-2006 – Standard for Installing Commercial Building Telecommunications Cabling
 - 5. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- E. Federal Communications Commission (FCC)
 - 1. FCC Part 15, Radiated Emissions Limits, revised 1998
 - 2. FCC Part 68, Connection of Terminal Equipment to the Telephone Network, revised 1998
 - 3. FCC Part 76, Cable Television Service, revised 1998
- F. Insulated Cable Design Consultants Association (ICEA)
 - 1. ICEA S-87-640 (2006) Fiber Optic Outside Plant Communications Cable
 - 2. ICEA S-98-688 (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
 - 3. ICEA S-99-689 (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors
- G. International Electrotechnical Commission (IEC)
- H. Institute of Electrical and Electronics Design Consultants, Inc. (IEEE)
 - 1. IEEE Standard 81-1983, IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System

2. IEEE Standard 1100-1999, Recommended for practice for Powering and Grounding Sensitive
 3. Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
 4. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
 5. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
- I. International Organization for Standardization (ISO)
1. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
 2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
 3. ISO/IEC 14443-3:2011 – Identification Cards
 4. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
- J. National Cable Television Association (NCTA)
- K. National Electrical Contractors Association (NECA)
1. NECA 1-2015 Good Workmanship in Electrical Construction
- L. National Electrical Manufacturers Association (NEMA)
1. NEMA C62.61 (1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits
- M. National Fire Protection Association (NFPA)
1. NFPA-70, National Electrical Code
 2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
 3. NFPA-101, Life Safety Code
 4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
 5. NFPA-780, Standard for the Installation of Lightning Protection Systems.
- N. National Institute Standards and Technology (NIST)
- O. Occupational Safety and Health Administration (OSHA)
- P. Security Industry Association (SIA)
- Q. Telecommunications Industry Association (TIA)
1. ANSI/TIA-568.0-D-1, Generic Telecommunications Cabling for Customer Premises.
 2. ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard.
 3. ANSI/TIA -568.0-D.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
 4. ANSI/TIA-568.3-D-1, Optical Fiber Cabling Components Standard.

5. ANSI/TIA-569-E Commercial Building Standard for Telecommunications Pathways and Spaces.
 6. ANSI/TIA-606-C, Administration Standard for the Telecommunications Infrastructure.
 7. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 8. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
- R. U.S. Department of Agriculture (USDA)
1. RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction
 2. RUS Bull 1751F-643 (2002) Underground Plant Design
 3. RUS Bull 1751F-815 (1979) Electrical Protection of Outside Plant
 4. RUS Bull 1753F-201 (1997) Acceptance Tests of Telecommunications Plant (PC-4)
 5. RUS Bull 1753F-401 (1995) Splicing Copper and Fiber Optic Cables (PC-2)
 6. RUS Bull 345-65 (1985) Shield Bonding Connectors (PE-65)
 7. RUS Bull 345-72 (1985) Filled Splice Closures (PE-74)
 8. RUS Bull 345-83 (1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
- S. Underwriters Laboratories, Inc. (UL)
1. UL 294 Standard for Video Surveillance System Units
 2. UL 294B Standard for Power Over Ethernet (PoE) Power Sources for Video Surveillance Systems and Equipment
 3. UL 109 Standard Method for Flame Tests of Flame-Resistant Fabrics and Films
 4. UL 1076 Standard for Proprietary Burglar Alarm Units and Systems

3.02 EXECUTION - GENERAL REQUIREMENTS

- A. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the aforementioned laws, ordinances, and rules, the matter shall be referred to the Architect / Design Consultant for direction before proceeding with that part of the work.
- B. Contractor shall meet the specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.
- C. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines. Equipment and materials installed by the Contractor shall be free of defects and damage.

- D. No deviations from the plans, details or specifications shall be made without full consent in writing of the Architect / Design Consultant. The Contractor shall have written approval from the Architect / Design Consultant for any additional work beyond the Contract Documents prior to beginning such work.
- E. Prior to execution, Contractor shall verify no changes in software, licensing or hardware versions have occurred since the bidding of the project. In the event of any changes, Contractor shall verify system compatibilities with their proposed design, and notify via RFI with the Architect / Design Consultant / Owner if the newest version(s) will require any upgrades / additional costs to the existing system(s).
- F. In the event site conditions do not allow the contractor to follow the execution requirements specified herein or in the provided details, the Contractor shall submit via RFI an alternative means and methods that is approved in writing by the Architect / Design Consultant / Owner.
- G. The Contractor shall obtain written permission from the Architect / Design Consultant / Owner before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to: girders, beams, floors, walls, roofs, and/or ceilings.
- H. If the Contractor does not obtain written approval from the Architect / Design Consultant / Owner prior to proceeding with the work, the contractor shall not be reimbursed for the work.
- I. Contractor shall notify the Architect / Design Consultant / Owner a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect / Design Consultant / Owner to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- J. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- K. Contractor shall be responsible for the repair of any damage caused by the contractor during the installation.
- L. Contractor shall test all cables prior to and post installation. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective at a later date.
- M. Contractor shall maintain a set of working specifications, design drawings, schedules, and record drawings to be kept on site at all times and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect / Design Consultant / Owner.
- N. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.
- O. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.
- P. Contractor shall make all stored equipment and materials available for inspection at the request of the Architect / Design Consultant / Owner.
- Q. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.

- R. All devices shall be installed flush, plumb, and (where required) centered on the wall, ceiling tile or structure for which it is being installed, unless otherwise noted.
- S. Devices installed in public spaces shall be mounted and secured using tamper-proof security fasteners unless otherwise noted.
- T. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.
- U. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.
- V. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- W. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.
- X. The manufacturer and contractor shall take positive measures to prevent the introduction of cybersecurity threats to the Owners technology infrastructure. These measures shall include but are not limited to:
 - 1. The contractor shall scan contractor owned equipment for cyber threats such as viruses, malware, ransomware, etc., prior to connecting the contractor owned devices to the Owners network.
 - 2. Ensure all technicians installing or configuring equipment are trained on the prevention of introduction of cyber threats to electronics, i.e., servers, and other associated equipment.
 - 3. All project documents shall be properly securely stored behind encryption and password protection to avoid unauthorized distribution of documents.

3.03 COORDINATION REQUIREMENTS

- A. The Contractor is responsible for the coordination of the following items and their respective disciplines included but not limited to.
- B. Coordinate with the Architect to ensure that:
 - 1. Adequate conduit is provided and that equipment backboxes are adequate for system installation.
 - 2. Adequate communication infrastructure and power has been provided and properly located for the security system equipment.
 - 3. Finishes and colors of all equipment visibly installed in public areas. Submit all finish and graphics for all equipment to the Architect for approval prior to installation.
 - 4. Camera views are not obstructed by landscaping, awnings, or any other obstacles.
 - 5. Mounting techniques are in compliance with construction techniques.
 - 6. Camera location and field of views are adequate and meets Owner's expectations.
- C. Coordinate with the Division 14 (Elevators) contractor for the following:

1. Pathways, installation, cabling, power requirements, media converter, and enclosures within the elevators shaft, wall, and/or elevator control room.
 2. Security device cable pathways and terminations to be done by elevator contractor or under direct supervision of elevator contractor.
 3. Any drilling or mounting in cab shall be performed by the Elevator Contractor. Security Contractor shall provide all security device mounting/drilling templates to the Elevator Contractor.
- D. Coordinate with the Division 26 contractor for the following:
1. Power requirements, conduit sizes/pathways, sleeves, back boxes, grounding, and bonding requirements of security devices in the following locations:
 - a. Interior of the building
 - b. Exterior of the building
 - c. Pole, pedestals, canopies, awnings, building architectural surface, etc.
 - d. Special conditions (clean room, hazardous areas, roof top mounted devices, etc).
 - e. License Plate Recognition (LPR) exact camera placement requirements.
 2. Coordinate location and termination of earth ground for all device specified herein as required per manufacturer installation requirements.
- E. Coordinate with the Division 27 contractor for the following:
1. Installation and power requirements of network infrastructure associated to the specified Video Surveillance System.
 2. Associated patch cable lengths and quantities required for the specified Video Surveillance System.
 3. Location, power, and backup requirements for rack mount equipment.
 4. Mounting and installation of injectors, midspans, extenders, surge protectors, etc.
- F. The Contractor is responsible for coordinating all VMS programming requirements with the Owner / Architect / Design Consultant.
- G. The Contractor shall coordinate with the Owner prior to installation for the following:
1. Network IP Addressing for Cameras, Servers, VMS Equipment
 2. Camera Views (Owner's Written Acceptance Required)
 3. Camera Labeling Scheme
 4. Firmware/software updates
 5. Client workstations requirements and locations
 6. Location of rack mount equipment.
 7. Locations, type, programming, configuration, and Owner's final expectations for Owner furnished Owner installed (OFOI) equipment and devices.

8. Uninterruptible Power Supply (UPS) requirements.
9. Programming including, but not limited to:
 - a. Camera Configuration
 - b. Recording Parameters
 - c. Live View Parameters
 - d. Admin / User Settings
 - e. Camera Analytic Detection and Event Triggering
 - f. VMS Software Configuration
 - g. User / Admin Groups
 - h. Camera Views
10. Painting of exposed, publicly visible conduit pathways

3.04 SYSTEM REQUIREMENTS

A. General

1. The Video Surveillance System (VMS) shall consist of server(s), software, licensing, workstations, cameras, power source, grounding/bonding, Video Surveillance cabling, and all other peripheral components as indicated on the drawing and specified herein.
2. Any devices associated with the installation shall have the latest firmware updates/downloads via Owner approved secure link from the system software and/or remotely from the manufacturer.
3. All Video Surveillance software, equipment and system requirements shall be installed per their respective Manufacturer Installation Guidelines.

B. Video Surveillance System (VMS) Software

1. Server/Client/Workstation/Mobile Application Software
 - a. The VMS software shall be installed as the most current version; contractor shall coordinate with Owner prior to the upgrade/install to identify and evaluate any software conflicts. Conflicts shall be brought to the attention of the Architect/Design Consultant prior to installation via written Request for Information (RFI). Contractor shall coordinate the install and configure software as required to provide a full turnkey VMS.
2. Video Surveillance System Integration Software
 - a. Per the Owner, there are no integration requirements at this time.

C. Video Surveillance System Licensing

1. Contractor shall be responsible for providing and applying all necessary licensing key(s) for the specified system(s) as required by the manufacturer(s) for a fully functioning Video Surveillance System.

2. Contractor shall maintain a secured document with all license key(s) information applicable to this project. All license key(s) are property of the Owner and shall be kept secured at all times and then surrendered to the Owner at the end of the project.

D. Video Surveillance System Programming

1. Programming and data entry to be provide by the Contractor with assistance from the Owner as required. Contractor shall program the Video Surveillance System to provide the following basic functions included but not limited to:
 - a. Database Importing (Active Directory, CSV file, etc.)
 - b. Graphics Maps
 - c. Time zones
 - d. System Reports
 - e. Role Based User System Access (Admin, User Privileges, Camera Views etc.)
 - f. Recording Parameters (FPS, Schedules, Events, etc.)
 - g. Digital or Analog Input / Output Relay Configurations and event triggering
 - h. ACS Integrations to the VMS (Door Control, Graphic Maps, etc.)
 - i. Special Conditions (License Plate Recognition (LRP), Facial Recognition, SB507, Thermal / Radar)
 - j. Event triggering via analytics including, but not limited to: (Perimeter fence, object left behind, masking, motion, etc.)

E. Video Surveillance System Hardware

1. Video Surveillance Server(s)
 - a. The Video Surveillance server(s) shall meet or exceed the VMS Manufacturer's requirements for the size and complexity of the Video Surveillance system being installed.
 - b. Contractor shall coordinate with Architect / Design Consultant / Owner for server(s) mounting location, communications, power, and additional requirements.
 - c. Contractor shall coordinate with the Architect / Design Consultant / Owner for any updates or changes to the submitted equipment as a result of changes technologies or updated requirements prior to installation
2. Communications
 - a. Communication between servers, workstations, and networked based edge devices will communicate using the Owner provided data network unless otherwise noted. Coordinate with Owner for network configuration requirements.
 - b. The VMS shall also support end to end 128-bit encryption unless otherwise noted.

F. Video Surveillance Workstation(s)

1. Client Workstation(s)

- a. The Operator / Client Workstation shall be Owner furnished / Owner installed (OFOI)
- b. Coordinate with the Owner for locations of Client Workstations(s)

G. Video Surveillance Cameras

1. The Contractor shall have all on-site equipment, and personnel necessary to install, program, and troubleshoot devices during and after installation.
2. Unless otherwise stated, all cameras shall receive power through Power over Ethernet. Contractor is responsible for ensuring the power output of the network switch will meet the power requirements of the cameras to be installed. Any additional power will be the responsibility of the contractor to provide.
3. PoE Injectors / Midspans / Extenders provided by the Contractor shall be securely mounted to the rack or wall per the manufacturer installation guidelines and / or Owner's standards.
4. The Contractor shall energize and commission equipment in accordance with manufacturer's instructions and guidelines. All installed cameras, mounts, accessories, and fasteners shall be properly rated for the environmental conditions in which they will be installed. Contractor is responsible for sealing and making watertight all exterior penetrations and equipment.
5. The Contractor is responsible for all the initial configuration of camera settings, IP address settings, recording settings, presets, naming conventions, etc. unless otherwise noted.
6. Default admin account usernames and passwords shall be reconfigured prior to connecting to the Owner's network. New admin accounts and passwords shall be Owner Provided. Account passwords and settings shall be held in confidence by the Contractor and secured throughout the duration of the project to prevent unauthorized access.
7. As part of initial installation, Contractor is responsible for focusing and aiming the camera in the direction as indicated in the drawings. Unless otherwise stated, camera lenses shall provide the maximum field of view coverage to the area to provide a usable, level, clear image, pending Owner's final approval. Contractor shall plan for a minimum of one additional trip to make final adjustments of camera field of views.

H. Surge Protection / Lightning Arrestors

1. Protect all exterior or interior devices, control, power, signal cables and conductors that are power surges. Each surge protector shall be UL Listed.
2. Unless otherwise noted, surge protection devices shall be installed at both the edge and head end of the cabling run.
3. Surge devices shall be installed as close as accessibly possible to the equipment they are protecting.
4. Surge Protection shall be properly installed in an accessible ceiling or enclosure space to allow for cable removal during troubleshooting.
5. Include surge protection device locations on as-builts and shop drawings.
6. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.

7. Properly ground surge protection devices per the manufacturer installation requirements.
- I. Video Surveillance Cabling
 1. Unless otherwise noted, all data cabling from end to end to support the Video Surveillance System and all related IP devices shall be furnished and installed by Division 27.
 2. Reference Division 27 Specifications and Drawings.
- J. Device Labeling
 1. Unless otherwise, all installed devices shall be labeled. Contractor shall verify device numbering scheme and Owner's current naming convention standard in writing in advance via RFI prior to generating any labels.
 2. Unless otherwise stated, all labels shall be machine printed and adhered to the device in a location that is visible and legible to the naked eye.
 3. All labeling in the field shall match the same labeling scheme in the closeout documents.
 4. Refer to Div. 27 specifications for data network device cabling requirements.
- K. Grounding and Bonding
 1. All grounding and bonding shall be performed by a licensed electrical contractor to ensure the electrical integrity of the low voltage system and devices specified herein per federal / state / local codes and standards.
 2. Contractor shall notify the Architect / Owner / Design Consultant via written RFI of any site conditions or installations that will require additional coordination.
 3. Contractor shall ensure proper grounding of shielded or non-shielded cabling and devices conform to the specified devices manufacturer's installation guidelines.
 4. The Division 28 Contractor is responsible for coordinating with the Division 26 Contractor for grounding and bonding security devices per applicable codes and standards.
- L. Conduit, Boxes and Raceways (For Reference Only - By Division 26)
 1. Install all conduit necessary for a complete installation but not limited to: in finished areas, in concealed areas, in chases, in furring's, in concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.
 2. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, industry-standard installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets, or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
 3. All conduits shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
 4. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.
 5. Swab out and remove all burrs from conduit before any wires are pulled.

6. Lay out and install conduit runs as to avoid proximity to hot pipes. In no case shall a conduit be run within 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least 25 mm from the covering of the pipe crossed.
7. Provide fire stops where conduits penetrate fire rated walls and/or floors.
8. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect.

M. High Voltage (120VAC) Power Requirements (For Reference Only – by Division 26)

1. 120VAC AC power dedicated to security shall be provided by the electrical contractor for the Video Surveillance system as indicated on drawings. Coordinate with the Architect to establish locations of security dedicated 120VAC AC circuits.
2. Connect to the AC power (provided by electrical contractor) and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.
3. Provide all conduit and wiring from the AC power facilities to the Video Surveillance / Power Supply Enclosures.
4. Provide Mechanical separation to isolate 120VAC wires from other low voltage cabling. Low voltage cabling shall not route over/under/parallel to 120VAC wires.

3.05 FIELD OBSERVATIONS

- A. A minimum of ten business days in advance, Contractor shall notify the Design Consultant and Owner as to the readiness for a Field Observation for the following at a minimum but not limited to:
1. Rough-In Observation – after conduits have been installed, but before walls have been installed.
 2. Above Ceiling Observation – after cabling has been installed, but before ceilings have been installed.
 3. Final Site Observation – a minimum of two weeks before Substantial Completion.
- B. During Design Consultant's Final Site Observation of the installed systems, provide a minimum of one factory-trained/certified technician on the operation of all installed systems for up to (1) 8-hour day to assist with Design Consultant's functional testing.
- C. Non-Conforming Work (Punch-List)
1. After receipt of written notice of deficiencies (Punch-List), Contractor shall correct all defective work within ten business days. If the work has been identified to be corrected by the Architect/Design Consultant, the Contractor shall remediate it in conformance with the contract documents at no cost to the Owner.

3.06 TESTING REQUIREMENTS

- A. Burn-in
1. As a prerequisite, the Contractor shall perform a burn-in of the system that is in accordance with the Manufacturer's installation guidelines.

- a. All devices shall be powered up and tested in a phased approach in a controlled testing environment on or off premise (to be coordinated with the Owner).
 - b. Update firmware with most up to date version (to be coordinated with the Owner).
 2. Each system hardware device shall remain operational during the burn-in test for a minimum of eight (8) hours without failure.
 - a. Contractor shall provide successful burn-in results in writing to the Architect / Design Consultant prior to final acceptance.
 3. Security Contractor shall conduct a complete QA/QC test of the entire Video Surveillance System and provide a written report of the test results (Punchlist). The tests shall include, but not limited to:
 - a. Hardware
 - b. Software
 - c. Network Connectivity
 - d. Device Power
 - e. Configure system device settings
 - f. Setting camera views (aim & focus)
 - g. Archiving of video footage
 - 1) Identify and remediate any issues and/or system faults
 4. It is the responsibility of the Contractor to verify that all devices, equipment, software, interfaces, sub-system interfaces and integrations are fully functional and operational.
 5. Contractor shall rectify all issues discovered during the QA/QC process and shall document these corrections via a Contractor provided punch-list.
 - a. At a minimum the punch-list shall contain:
 - 1) Date of the item identified
 - 2) Description of the discrepancy with photographs, as necessary.
 - 3) Date the item was rectified
 6. All QA/QC items shall be corrected, and an electronic report surrendered to the Architect / Design Consultant prior to calling for Substantial Completion.
- B. Contractor shall complete a functional test of each component of all provided and installed systems and equipment. These tests shall include, but is not limited to:
 1. Hardware
 2. Software
 3. Network Connectivity between system components
 4. Device Power
 5. System Configuration Settings

6. Device parameters and views (aim & focus)
7. Recording and archiving of events

3.07 TRAINING REQUIREMENTS

- A. Provide for (8) hours of training to the Owner and/or Owner's representatives. Coordinate with Owner for the exact training intent, times, dates, and duration of each training session.
- B. Provide a test report showing the system has been 100% tested and 100% operational prior to training / demonstration.
- C. Coordinate with the Owner to establish a training outline and schedule. Submit a comprehensive training curriculum to the Owner once all preliminary coordination is complete. The Owner will revise and comment on the curriculum as required.
- D. Contractor training shall be conducted onsite/virtually with a Manufacturer's representative in attendance.
- E. Operator training shall include, but not be limited to the following:
 1. General routine operations and procedures
 2. Live views
 3. Share videos
 4. Alarm acknowledgement, alarm response logging, and map graphics functionality
 5. Manipulation of cameras and presets.
 6. Archiving recorded video
- F. Administrative training shall include, but not be limited to the following:
 1. All operating system procedures listed above, in addition to the following:
 2. Cyber hardening / password protection / best practices
 3. Camera / system configuration
 4. Rules configuration
 5. System configuration
 6. User assignments / permissions
 7. Report generation
 8. Rule creation and configuration
 9. Other subjects but not limited to analytics, forensics, and integrations.
- G. Record, label, and catalog all training on an Owner approved digital media and "user's manual" written specifically for the Owner personnel onsite, for daily routine operations of the systems. Provide the digital media and user's manual to the Owner for future in-house training sessions and / or reviews. Furnish all temporary equipment necessary for recording all training sessions. Maintain accurate and up-to-date time sheets of all training sessions.

- H. The Owner reserves the right to use any excess training hours, not used by the time of system completion, for future training as requested until the total number of training hours has been completed.

3.08 PROJECT CLOSEOUT DOCUMENTATION REQUIREMENTS

A. As-Built Drawings

1. Drawings shall be provided to the Architect / Owner / Design Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect / Owner / Design Consultant.
2. Unless otherwise requested, Contractor shall provide digital copies of close-out documents, and deliver to the Architect / Owner / Design Consultant electronically.
3. As-Built drawings shall be produced in AutoCAD/Revit in the most current or compatible version and provided electronically in .dwg and/or .pdf format.
4. Drawings shall be provided in the original size as issued by the Architect/Design Consultant.
5. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect/Design Consultant.
6. Provide a conformed set of Drawings as related to the project, depicting the condition of the Video Surveillance system as installed to include but not limited to:
 - a. ASI, PR and Addendum items installed throughout the duration of the project.
7. Provide a hard copy of the conformed set of drawings to be physically stored at the end of the project in a designated Video Surveillance System enclosure. Coordinate with Owner for final storage location.
8. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of the following not limited to:
 - a. Video Surveillance System Riser / Signal Flow Diagrams
 - b. Video Surveillance System Backboard Layouts
 - 1) To include Video Surveillance boards, power supplies, pathways, etc.
 - c. Sleeves, Backbone Cabling and Communication pathways
 - d. Video Surveillance System device locations and labeling scheme.

B. Operation & Maintenance Manuals

1. Unless otherwise noted, provide O&M manuals electronically to Owner to include all drawings, product datasheets, hardware manuals as related to the project.
2. Coordinate with the Owner for provisioning of physical storage devices (Hardcopy, Flash Drive, CD/DVDs)

C. Spare Parts

1. Contractor to provide 10% spare parts as indicated below:

- a. Interior Camera and all associated mounting hardware specified.
 - b. Exterior Camera and all associated mounting hardware specified.
 - c. Surge protection, associated models and all associated mounting hardware as specified.
2. The cost for these spare parts shall be included in the cost of the project. Spare parts are to be turned over to the Owner at substantial completion for storage.
 3. These parts shall be delivered to the Owner with transmittal letter prior to final system acceptance.
- D. Manufacturer's Product Warranty
1. Certificate of product warranty shall be provided to the Architect / Owner / Design Consultant at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect / Design Consultant.
 2. The manufacturer of the solution shall furnish a product warranty as per the specifications starting at final system acceptance.
 3. One original and two copies of the Manufacturer's product warranty shall be provided.
- E. Contactor's Statement of Warranty
1. Statement of warranty shall be provided to the Architect/Design Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect/Design Consultant.
 2. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
 3. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e., Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION 28 23 00